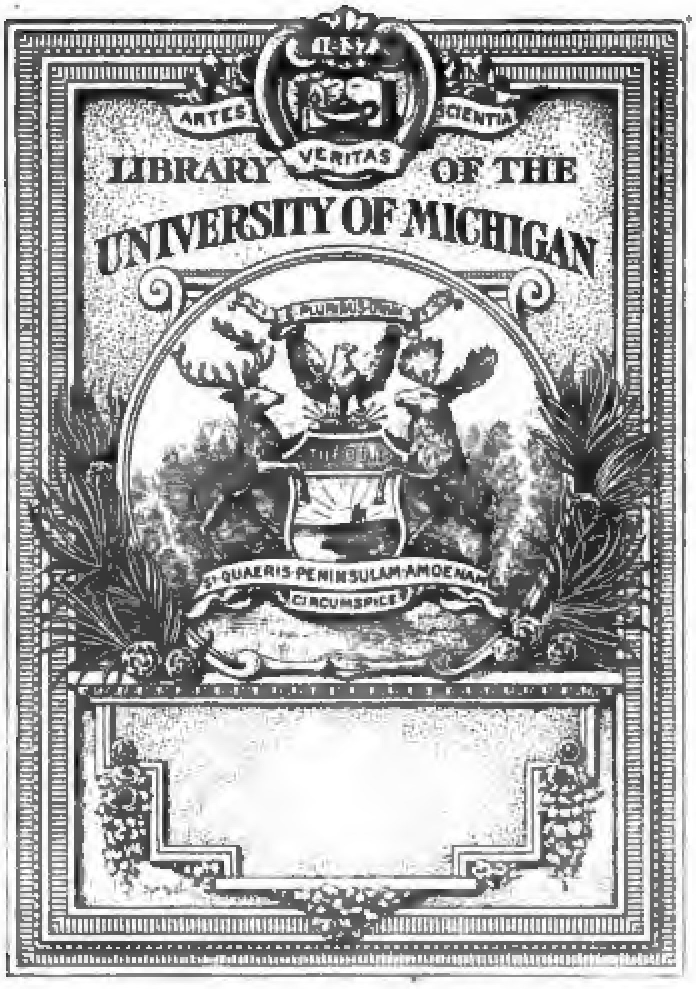
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# PROCEEDINGS.

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OF THE

# Royal Society of Victoria.

## VOL. VII. (New Series).

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# CONTENTS OF VOLUME VII.

## Art. I.—*Observations with Kater's Invariable Pendulums made at Sydney during January and February, 1894; with an Appendix on the Stability of the Pendulum Stand.*

(With Diagram).

By E. F. J. Love, M.A.

[Read 8th March, 1894.]

### Introductory.

The object of this investigation was to throw some additional light on the question of the difference between the values of $g$ at Melbourne and Sydney. Two determinations of this difference had already been made; the officers of the United States Coast Survey swung the Kater pendulums at Sydney in 1883, these pendulums being also swung by Mr. Baracchi at Melbourne in 1893; while Lieutenant Elblein swung three of von Sterneck's pendulums at Melbourne and at Sydney in the winter of 1893. When these two sets of results came to be compared,* they were found to be inconsistent; the U.S. Coast Survey figures, combined with those of Mr. Baracchi, show that a pendulum beating approximately seconds should lose 8·58 vibrations per day, if transferred from Melbourne to Sydney; while Lieutenant Elblein's figures give 13·48 as the loss per day. I accordingly decided to swing the Kater pendulums again in Sydney at the earliest opportunity; and, as a matter of fact, the observations in Sydney succeeded those of Mr. Baracchi in Melbourne by a little more than three months. During the interval I made a few measurements in Melbourne; these agree in the main with those of Mr. Baracchi, but are so much less elaborate that there is no need to publish them. The observations in Sydney follow my own in Melbourne at an interval of five weeks. We may therefore reasonably consider that the comparison between Melbourne and Sydney recently secured lacks nothing in point of directness.

* Baracchi—Proc. Roy. Soc. Vict., 1893, p. 176.

## Arrangements.

The pendulums and subsidiary apparatus* were carefully packed at the Melbourne Observatory and shipped to Sydney, whither I proceeded on 19th January. Mr. Russell, the Government Astronomer at Sydney, had very kindly placed at my disposal the cellar in which the experiments of the U.S. Coast Survey party, and subsequently those of Lieutenant Elblein, had been carried out; and as the exact position of their apparatus in the cellar is known I erected mine on the same spot. The cellar itself is almost an ideal room for the purpose. Three of the walls are of brick; one, which is two feet ten inches thick, is directly in contact with the earth outside, forming part of the foundation wall of the Observatory; the other two, which are two feet four inches thick, form partition walls separating the room from adjoining cellars, as does also the fourth wall, which is a mass of stone four feet three inches thick, and supports the Transit instrument. At either end of the Transit wall are narrow passages communicating with the adjoining cellar. The ceiling, which is of wooden panels, is level with the ground outside. There are no windows; but at the east end—remote from the pendulum apparatus—a staircase leads up into the Transit room. The dimensions of the cellar are twenty-four feet by six feet five inches by seven feet seven inches. As might be expected from this description the diurnal variation of temperature cannot be detected in this room, even by experiments specially carried out for the purpose.†

The floor, on which the pendulum stand was erected, consists of six inches of concrete resting directly on a bed of very hard clay containing a large number of iron stone nodules. This clay bed, which is nearly one foot thick, is in its undisturbed natural condition and very solid; it rests directly on the Sydney sandstone. A method of testing the stability of the apparatus—and of the floor too—is given in the Appendix.

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* Described in the Report of the Gravity Survey Committee for 1892—Proc. Roy. Soc. Vic., 1892, p. 219.

† I kept the thermographs running whether I were at work or not; on certain days no one entered the cellar, and the records for those days are straight lines. A range in temperature of 0·1° Fahr. could be detected at once by the wave it would produce in the line; but none such was found.

The Shelton clock was supported by a couple of ⅞in. planks, each of these being secured by large screws to four plugs inserted about eight inches into the wall at the west end of the cellar. The clock was attached to the planks by three screws, and set vertically by inserting mahogany wedges between the planks and the clock case. The verticality, as tested by the spirit level attached to the clock, was well maintained during the whole series of observations.

The relative positions and distances of the apparatus were identical with those employed in Melbourne,* save as regards the position of the observing telescope (*vide infra* p. 5). The operation of inserting the pendulums into the cylinder was considerably simplified by cutting holes in the ceiling of the cellar, and in the floor of the room above; Mr. Russell would then hand the pendulum down through the hole, I receiving it below and guiding it into the cylinder; in this way the pendulums, when not lying in their boxes, were always kept in a vertical position and supported by their upper ends, so that risk of accidental bending was practically eliminated. The uppermost of the two holes, when not in use, was kept closed by a board chamfered to fit its edges, and above this again was a sheet of linoleum; no draught or air circulation through the holes was ever detected during the swings.

## Pressure and Temperature.

The experiments were carried on under atmospheric pressure, the pressure being recorded by a marine barometer lent me by Mr. Russell; the cistern of the barometer was placed approximately on a level with the bob of the experimental pendulum. The barometer corrections are given in Table I.

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* Baracchi, *l.c.*, p. 164-66.

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The temperature was determined as in Melbourne by means of the thermometers, K667 used in the inverted position, and K668 in the erect position, both attached to the dummy; and as a check on any irregular variations of temperature, the two Richard thermographs were employed. The tracings furnished by these were in all cases so regular, that the mean of the thermometer readings, with the correction $-0^{\circ}13$ applied, could be always taken as representing the mean temperature of the pendulum with sufficient accuracy. The thermometers and barometer were read before and after the observations at the beginning and end of a set of swings; and each recorded reading is therefore the mean of four observations. The fluctuations in barometric pressure were also observed by means of the Observatory barograph; though not large enough to sensibly effect the pressure correction, they influence the observations in another manner, as described in the concluding paragraph of this paper.

### Arc of Vibration.

This was read on the arc scale behind the tail-piece of the pendulum, as in previous observations with this apparatus.

### Levelling.

The agate planes of suspension for pendulums No. 4 and No. 6 were adjusted to horizontality with the aid of two small but very sensitive levels sent out with the apparatus; each of these stands on three sharp points. The agates belonging to No. 11, being cylinders instead of planes, could not be adjusted with these levels; the two flat-based levels sent out with this pendulum are very sluggish, and not very sensitive; I accordingly employed a very delicate flat-based level, kindly lent me by Mr. Ellery. The planes generally remained in good adjustment as tested by relevelling at the close of the series for each pendulum.

### Observation of Coincidences.

In setting up the apparatus the observing telescope had to be rotated to the left of the vertical, so that the observer sat with the pendulum stand on his left. The disappearance and reappearance of the apparent left edge of the image of the disc on the

TABLE I.

COPY OF CERTIFICATE OF MARINE BAROMETER, C758, ISSUED BY THE KEW (ENG.) OBSERVATORY.

| At | in. 27·5 | in. 28·0 | in. 28·5 | in. 29·0 | in. 29·5 | in. 30·0 | in. 30·5 | in. 31·0 | Correction to attached Thermo'ter at 62° | Time of falling one inch. |
|---|---|---|---|---|---|---|---|---|---|---|
| | -0·010 | -0·009 | -0·007 | -0·006 | -0·005 | -0·003 | -0·002 | -0·001 | +0°.3 | 5 min. 50 sec. |

These corrections include those for index error capacity and capillarity.

(Signed) G. M. WHIPPLE, *Supt.*

NOTE.—Compared with the standard in Sydney, the error was 0·001 greater.—H. C. R.

The temperature was determined as in Melbourne by means of the thermometers, K667 used in the inverted position, and K668 in the erect position, both attached to the dummy; and as a check on any irregular variations of temperature, the two Richard thermographs were employed. The tracings furnished by these were in all cases so regular, that the mean of the thermometer readings, with the correction – 0°13 applied, could be always taken as representing the mean temperature of the pendulum with sufficient accuracy. The thermometers and barometer were read before and after the observations at the beginning and end of a set of swings; and each recorded reading is therefore the mean of four observations. The fluctuations in barometric pressure were also observed by means of the Observatory barograph; though not large enough to sensibly effect the pressure correction, they influence the observations in another manner, as described in the concluding paragraph of this paper.

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This was read on the arc scale behind the tail-piece of the pendulum, as in previous observations with this apparatus.

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### Observation of Coincidences.

In setting up the apparatus the observing telescope had to be rotated to the left of the vertical, so that the observer sat with the pendulum stand on his left. The disappearance and reappearance of the apparent left edge of the image of the disc on the

clock pendulum were in every case selected for observation; this edge would be the apparent right edge to an observer on the opposite side of the room, and consequently was the same as that observed in Melbourne. The card disc on the clock pendulum was that used in Melbourne, and the method of observing was the same as that adopted in Melbourne, Kew and Greenwich. Four sets of swings, two for each face, were effected with each pendulum, the two sets for any one face being taken on the same day. The discordance between the results for opposite faces with the Pendulum No. 11* was very marked; but there is no doubt that this pendulum is slightly bent, and very little question that its knife-edges are not accurately perpendicular to the pendulum bar. I noticed both these defects on the first arrival of the pendulums from England. Fortunately, so long as they are constant they do not affect the accuracy of differential observations.

## Clock Rates.

The Shelton clock was compared directly with the Siderial clock of the Observatory at the beginning and end of each day's work, in order to determine the difference of their rates. The comparison was effected by means of a tape chronograph of Morse's pattern, constructed by Messrs. Siemens Bros., which worked very uniformly. The chronograph spaces were measured off by means of a divided lens, the halves of which were mounted on brass sliding pieces carrying scales; this instrument being used in much the same way as the heliometer. The scales were graduated in inches and tenths, and hundredths were estimated.

The error of the Siderial clock was determined by Transit observations. Unfortunately the nights were so cloudy for most of the time that star observations could not always be obtained, and sun transits had perforce to be resorted to; this cannot, however, have affected the results to any serious extent, as on those occasions when both sun and stars were observed the difference of the deduced rates was never more than one or two hundredths of a second. Both clocks behaved well; their rates are given in Table II.

---

* Alluded to by Baracchi, *l.c.*, p. 166.

TABLE II.

| Date. | January. | | | February. | | | | |
|---|---|---|---|---|---|---|---|---|
| | 29 h | 30th | 31st | 1st | 2nd | 3rd & 4th (Me n). | 5th | 6th |
| Rate of Siderial Clock belonging to the Observatory - - | −0·54 | −0·54 | −0·50 | −0·43 | −0·63 | −0·72 | −0·54 | −0·50 |
| Rate of Shelton Clock - - | +7·18 | +7·06 | +7·06 | +6·99 | +6·62 | +7·12 | +7·10 | +7·12 |

The Observatory Siderial had, as the table shows, a losing rate, and the Shelton clock a gaining rate, throughout the series.

In order to render these results comparable with those taken at other places they must be reduced to vacuum and sea-level.

The reduction to vacuum is

$$0\cdot34\frac{26}{1+\cdot0023\times30}=26\times0\cdot34\div1\cdot069=8\cdot2693.$$

The height of the pendulum-bob above the sea-level is given by Mr. Russell as 140 feet.

The reduction to sea-level is therefore $\frac{140}{243}=\cdot5761$.

The sum of the two corrections is 8·8454 or to a sufficient degree of approximation 8·85.

Hence we obtain as the finally reduced vibration numbers

| | | | |
|---|---|---|---|
| Pendulum No. 4 | ... | ... | 86095·95 |
| " 6 | ... | ... | 85995·97 |
| " 11 | ... | ... | 86047·25 |

The values given by Mr. Baracchi for Melbourne are

| | | | |
|---|---|---|---|
| Pendulum No. 4 | ... | ... | 86107·89 |
| " 6 | ... | ... | 86008·05 |
| " 11 | ... | ... | 86059·68 |

Hence we obtain for the difference $M-S$.

| | | | |
|---|---|---|---|
| Pendulum No. 4 | ... | ... | 11·94 |
| " 6 | ... | ... | 12·08 |
| " 11 | ... | ... | 12·43 |
| Mean | ... | ... | ... 12·15 ± 0·19 |

DISCUSSION OF THE RESULTS, AND COMPARISON WITH THEORY.

The first conclusion deducible from these results is that the difference between the vibration numbers for Melbourne and Sydney cannot be deduced from a comparison of the investigations of the U.S. Coast Survey officers with those of Mr. Baracchi, for the difference between the value thus obtained, viz.:—8·58 ± 0·32, and the value 12·15 ± 0·19 given above, is more than eleven times the probable error of the first, and nineteen times the probable error of the second. It cannot, therefore, be attributable to unavoidable errors of observation.

Furthermore, the difference cannot be attributed to personal equation as between Mr. Baracchi and myself; for if I use my

own (Melbourne) observations* instead of Mr. Baracchi's, I get nearly the same mean result, though with a larger probable error, $M-S$ coming out $12{\cdot}20 \pm 0{\cdot}47$; the difference 0·05 between the two values (which is less than the probable error of the determination made by either of us, and therefore within the limit of experimental error), is only one-seventieth part of the difference between the results of the two investigations at Sydney.

On the other hand the difference between the values for $M-S$ obtained by Lieutenant Elblein and myself is not extravagant, seeing that our apparatus and mode of experimenting are quite different; moreover, Lieutenant Elblein told me that he looked upon 1 in 100,000 as about his limit of accuracy for any one place; hence his limit of accuracy for the difference between two places would be about 1·7 vibrations per day. My own probable error for a similar difference is about 0·2 vibrations per day; hence the difference of 1·33 between Lieutenant Elblein and myself is well within the limit of experimental error.

We may therefore feel tolerably certain that, if we adopt 12·2 as the value of the difference between the vibration numbers at Melbourne and Sydney, we shall not be far from the truth.

If we compute by Clairaut's formula† the differences between the vibration numbers at Greenwich, Melbourne, and Sydney, and compare the figures thus obtained with the experimental values, we obtain some interesting results, which strongly bear out the deductions of the previous section.

The calculation is effected thus:—

Clairaut's theorem may be put into the form

$$V^2 = V_0^2 \left\{ 1 + \left(\frac{5}{2}m - e\right)\sin^2\lambda \right\} \quad - \quad - \quad - \quad - \quad (1).$$

where $V$ denotes the vibration number in latitude $\lambda$, $V_0$ the equatorial vibration number, $m$ the ratio of the centrifugal force at the equator to the force of gravity there, $e$ the ellipticity of a meridian.

* Referred to *supra* p 1. There is, indeed, no reason to suppose that personal equation has any effect on the results of pendulum observations; the results for each station are themselves deduced from the differences between pairs of epochs, and as each epoch of a pair will be affected by the observer's personal equation to the same extent, this source of error is in all cases eliminated.

† It should be mentioned that—in order to avoid any risk of bias in favour of either Lieutenant Elblein's result or that of the U.S. Coast Survey—the calculations here given were intentionally not effected until the observations at Sydney had been completed and reduced.

Hence we obtain, if $V_1$ and $V_2$ are the vibration numbers in latitudes $\lambda_1$ and $\lambda_2$

$$\frac{V_1^2 - V_2^2}{V_1^2} = \left(\frac{5}{2}m - e\right)\frac{\sin^2\lambda_1 - \sin^2\lambda_2}{1 + \left(\frac{5}{2}m - e\right)\sin^2\lambda_1} \quad - \quad - \quad - \quad (2).$$

$m$ is known to be very accurately expressed by 0·0034674; the mean value for $e$ obtained by Colonel Clarke from a comparison of all previous observations is 0·0034223; whence $\frac{5}{2}m - e = 0{\cdot}00525$ with sufficient accuracy for our purpose. Owing to the smallness of this quantity we may omit the term depending on it in the denominator of the right-hand member of equation (2); furthermore, as $V_1 - V_2$ is small compared with $V_1$ or $V_2$ we may write the equation thus

$$2\frac{V_1 - V_2}{V_1} = \left(\frac{5}{2}m - e\right)\left(\sin^2\lambda_1 - \sin^2\lambda_2\right) \quad - \quad - \quad - \quad (3).$$

For $V_1$ in the denominator of the left-hand member of equation (3) we may substitute 86000 without sensible error; and we obtain

$$\begin{aligned} V_1 - V_2 &= 43000 \times 0{\cdot}00525 \times (\sin^2\lambda_1 - \sin^2\lambda_2) \\ &= 225{\cdot}75(\sin^2\lambda_1 - \sin^2\lambda_2) \quad - \quad - \quad - \quad (4). \end{aligned}$$

the formula used in the computation.

The latitudes are as follows:—

Greenwich : $\lambda_1 = 51^\circ\ 28'\ 31''$.
Melbourne : $\lambda_2 = -37^\circ\ 49'\ 53''$.
Sydney : $\lambda_3 = -33^\circ\ 51'\ 41''$.

The experimental values for Greenwich, Melbourne, and Sydney are summarised in Table IV.

Table IV.

| Station and Observer. | | Greenwich (Hollis) | Melbourne (Baracchi) | Sydney (Love) |
|---|---|---|---|---|
| Pendulum - - | No. 4 | 86165·19 | 86107·89 | 86095·95 |
| | No. 6 | 86065·09 | 86008·05 | 85995·97 |
| | No. 11 | 86116·83 | 86059·68 | 86047·25 |

From this table we obtain the following differences:—

TABLE V.

| Pendulum. | $G-S$ | $M-S$ | $G-M$ |
|---|---|---|---|
| No. 4 - - - | 69·24 | 11·94 | 57·30 |
| No. 6 - - - | 69·12 | 12·08 | 57·04 |
| No. 11 - - - | 69·58 | 12·43 | 57·15 |
| Mean - - - | 69·31 | 12·15 | 57·16 |
| Calculated - - | 68·03 | 14·82 | 53·21 |
| Obs$^{d.}$ – Calc$^{d.}$ | +1·28 | –2·67 | +3·95 |

Hence, according to Clairaut's theorem the vibration number recently obtained for Sydney is too large as compared with that for Melbourne, and too small as compared with that for Greenwich; while the observed vibration number for Melbourne departs even more widely from that for Greenwich, being nearly four vibrations less than the formula would allow. Unless the pendulums have undergone some serious change in the course of the voyage out, such change being nearly reversed during the voyage to Sydney—a very unlikely concatenation of events—the conclusion to which the figures lead is a defect of gravity at Melbourne, and a similar but much smaller defect at Sydney, as compared with Greenwich. Setting aside any possible difference between the observed and calculated values due to the difference in longitude between Greenwich and the Australian stations,* we may observe that this result was exactly what we might expect. Melbourne being situated forty miles from the open ocean, and about 250 from the deep water marked by the 200 fathom line, is much more of a continental station than Sydney, which is near to the Pacific coast, and on a line with most of it, the 200 fathom line being here within a few miles of the shore; Greenwich, again, is on an island. The general result of pendulum work is to show that proximity to the ocean in continental stations raises the value of $g$ for any given latitude, while an

* We know the figure of the Earth with sufficient accuracy to affirm that any effect arising from difference of longitude must be extremely small.

insular situation raises it still more: consequently $M - S$ should be smaller, $G - S$ greater, and $G - M$ still greater than the calculated value, as is the case.

If, however, we take the U.S. Coast Survey result, all three differences fall below the calculated value; $M - S$ in particular becomes absurdly small, unless we are prepared to assert that $g$ has an abnormally high value at Sydney, owing to local peculiarites which cannot well be allowed for. Such an assertion appears to me to be quite unwarrantable in view of the agreement between the recent determinations of Elblein and myself; and I am in consequence reluctantly compelled to assume that the U.S. Coast Survey determination must not be employed differentially in connection with recent observations with the Kater pendulums.

What the source of the discrepancy may be it is not so easy to determine. The following suggestions may be made :—

*(a)* That some change has taken place in *all* the pendulums since 1883.

*(b)* That some error has crept into the reduction of the American observations.

*(c)* Errors of observing.

Of these *(c)* is practically out of the question, as all three pendulums give nearly the same result; besides the known skill and ability of the American observers would negative such a hypothesis.

*(a)* is inadmissible; for Herschel's measurements with these pendulums at Kew and Greenwich in 1882 agree very well with those made by Hollis and Constable in 1889, consequently no such change can have occurred during that interval; while the values of $G - M$, $M - S$, and $G - S$, as recently determined, negative the supposition of any serious change between 1889 and 1894.

*(b)* seems the only possible solution; and it is noteworthy that the error, whatever it be, affects all the pendulums alike. The possible sources of error which could give such a result are limited in number; the only one which suggests itself to me is a systematic change in the sign of the clock rate. Whether anything of this kind has occurred I cannot tell, as I have of course been unable to refer to the original notes of the American observers, which alone could be relied on to settle the matter.

## Conclusion.

In the course of the observations, both here and in Sydney, a curious circumstance presented itself, which seems to indicate a peculiarity in the behaviour of the Shelton clock. Any *very rapid* change in the barometric pressure always calls forth *while it is progress* a change in the clock rate. As cases in point, the observations of 30th January and 5th February may be cited. On both these days the barometer fell rapidly during the first series of observations, and the value of $V$ is on 30th January considerably higher for the second series than for the first, while on 5th February the reverse is the case. When, however, no sudden changes of pressure occur the difference between the numbers obtained on the same day is always quite small. Can this be a special property of gridiron pendulums? If so, the following explanation may be tentatively suggested. Possibly, owing to the friction between the rods, the geometrical form of a gridiron pendulum normally lags behind the condition proper to the actual temperature; and the sudden changes of pressure may act like slight shocks, enabling it to suddenly overcome this friction.

In concluding this paper I must express my gratitude to Mr. Russell, who not only placed the resources of the Observatory at my disposal, and aided me in the work in every possible way, but also treated me with the greatest kindness and hospitality during my stay in Sydney. My thanks are also due to the members of the Observatory staff, especially to Mr. Linehan, the chief assistant, who took a great deal of trouble over the clock rates, and helped me in other ways. Lastly, I would express my obligations to the New South Wales Railway Commissioners for their kindness in granting me a free pass over their lines.

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## Appendix.

### *On the Stability of the Stand on which the Kater Pendulums are swung.*

The copper cylinder in which the pendulums are vibrated, together with the massive timber and iron framework which carries it, was constructed at Dehra Dun for the Indian Trigono-

metrical Survey. I cannot discover any record of experiments directed to discover whether the vibrations of the pendulums set up any corresponding vibration in the cylinder. It appeared desirable to investigate the question; and Mr. Russell very kindly constructed the apparatus here described, and assisted in the conduct of the experiments made with it.

The apparatus is figured in Plate I. *ABD*, Fig. (1),* is an L-shaped brass plate, to which two small plates *M*, *M*, Figs. (1) and (2), are soldered above and below. Through the plates *M*, *M*, screws *T*, *T*, Fig. (2), are passed, terminating in conical pivots which work easily in sockets in the brass plate *EF*; *G*, Fig. (1), is a weak spring fastened to *EF*, and bearing against the arm *AB* of the L-shaped piece, so that when left to itself the arm *BD* is pressed into contact with *EF*; to the arm *BD* a mirror, *C*, is cemented; *P*, Figs. (1) and (2), is a conical steel spike. The plate *EF* is secured by three screws to the wooden block *K*, which is itself screwed to the top of a large iron drum, *H*, filled with water, which stands on the floor. When in use the point of the spike *P* rested perpendicularly against the north window of the cylinder, against which it pressed with sufficient force to bring the arm *BD* parallel to the plate *EF*; it was found that a force equal to the weight of 0·25 ounces was required for this purpose. The plane of the thrust is parallel to the plane of vibration of the pendulum.

At the other end of the cellar a frame carrying a telescope and scale was supported by means of a similar iron drum filled with water, to which it was screwed, in such a way that an image of the scale was thrown into the telescope by the mirror; the telescope was provided with a single vertical crosswire. The arrangement of the telescope and scale is shown in Figs. (3), (4) and (5), and needs no further explanation. The scale was divided on ground glass into inches and tenths, and illuminated by a small bull's-eye lantern placed behind it on the frame. A displacement of one-tenth of a scale division in the image would have been easily detected, especially if oscillatory.

The dimensions of the apparatus were as follows:—Distance from point of spike *P* to vertical line of pivots, 0·75 in. Distance

* Fig. (1) is horizontal, Fig. (2) is vertical.

from scale or object glass to mirror, 167·0 in. Distance from plane of spike to plane of support of cylinder, 43·0 in. An oscillation in the image of amplitude 0·1 scale division (0·01 in.) would accordingly correspond to an angular displacement in the cylinder expressed by

$$\frac{0\cdot01}{167} \times \frac{1}{2} \times \frac{0\cdot75}{43} \times \frac{648000}{\pi} = 0\cdot108 \text{ seconds of arc.}$$

To see whether the apparatus responded easily to small disturbances the following experiments were carried out :—

*(a).* To test the effect of unsymmetrical vertical thrust.

A brass cylinder weighing 13 oz. was placed in a vertical position on the ledges of the north and south windows of the cylinder alternately; the readings obtained were

| No Load. | | Load on S. window. | | Load on N. window. |
|---|---|---|---|---|
| 21·8 | ... | —— | ... | —— |
| —— | ... | 21·2 | ... | —— |
| —— | ... | —— | ... | 22·2 |
| —— | ... | 21·2 | ... | —— |
| —— | ... | —— | ... | 22·1 |
| —— | ... | 21·2 | ... | —— |
| —— | ... | —— | ... | 22·2 |
| 21·8 | ... | | ... | |

[NOTE.—The pendulum cylinder is fully 100 times the mass of the small brass cylinder employed in this experiment.]

Hence the mean displacement on loading the S. window was 0·6, while the mean displacement on loading the N. window was 0·4; or, in other words, 2½ oz. on the S. window, or 3 oz. on the N. window could be detected. As the line joining two of the three supporting screws of the cylinder ran east and west, and to the south of the third screw, this difference might be reasonably expected; for the load on the south window would tend to relax the pressure on the third levelling screw by rotating the whole cylinder about the E. and W. line through the other two.

*(b)* To test the effect of horizontal thrust.

The piece of apparatus shown in Figs. (6) and (7) was constructed for this purpose*; *abc* is a brass plate bent nearly at a

* Fig. (6) is vertical, Fig. (7) horizontal.

right angle, and carrying a steel spike *d*; *ff* is another brass plate with a recess cut out at one end to allow the arm *bc* to pass; *e*, *e*, are screws with conical ends, passing through *ff* and bearing into holes in the line of bending of the plate *abc*, thus forming pivots about which it can turn easily; *g* is a circle traced on the upper side of *ab*, its centre being at the same distance from the line of the pivots as is the point of *d*. When in use the point of the spike *d* rested against the south window of the cylinder, the arm *ab* being just lifted off the plate *ff* by the pressure. A mass *h* being placed on *g*, the lever *abc* transmits a horizontal thrust to the cylinder equal to the weight of *h*. The plate *ff* was screwed to a wooden block, in its turn screwed to the top of an iron drum filled with water.

With a brass 1 oz. weight the following readings were obtained·

| Loaded. | | Unloaded. |
|---|---|---|
| 6·2 | ... | — |
| — | ... | 7·0 |
| 6·2 | ... | — |
| — | ... | 7·0 |

Consequently a horizontal pressure in the plane of oscillation of the pendulums equal to the weight of $\frac{1}{8}$ oz. would produce a deflection of 0·1 scale divisions.

(*c*) To test the effect of small impulses.

Taps with the finger dealt as lightly as possible to the south window caused deflections of several scale divisions; the resulting oscillations were however damped out after two or three swings.

The sensitiveness and delicacy of the apparatus being thus demonstrated, the pendulum (No. 11) was set in vibration through an arc about equal to the largest employed in the coincidence observations, and examined at intervals during a quarter of an hour. On no occasion could the slightest trace of oscillation be detected, the image of the scale remaining to all appearance absolutely steady on the crosswire.

The distance betweeen the knife-edges and the plane of support of the cylinder was about six inches; and since the angular excursion, if any existed, could not as shown exceed 0″·05 on either side of the vertical, the maximum possible linear displacement of the knife-edge from its equilibrium position may be put down as 0·00003 inches, which is about one ten-

thousandth part of the semi-amplitude of the excursions of the pendulum bob. The sufficient stability of the apparatus is amply guaranteed by this result.

Early in the course of the experiments it was noticed that certain changes in the position of the observer, when near the pendulum stand, caused changes in the zero reading, the maximum displacement being produced by the experimentee's crossing the room from north to south or *vice versâ*. Accordingly the observer who adjusted the weights in the statical experiments always retired to a marked position in the room before readings were taken. It appeared worth while to examine the changes in the floor-level thus produced: and the following tests were made for this purpose.

A lead cylinder, weighing 38¼ lbs., was placed at the foot of the south and north pillars of the stand alternately; the readings were

| Wt. near South pillar. | | Wt. near North pillar. |
|---|---|---|
| 20·9 | ... | —— |
| —— | ... | 21·7 |
| 20·9 | ... | —— |
| —— | ... | 21·7 |
| 20·9 | ... | —— |
| —— | ... | 21·8 |

Hence the displacement of the weight through a space of five feet on a floor six feet five inches wide, caused a change of level amounting to $0''\cdot86$, which would correspond to a depression by the weight amounting to 0·00024 inches. Considering the solidity of the flooring, this at first surprised me a good deal; until I reflected that a load of a couple of tons would produce under the same circumstances a depression of about 0·2 inches: now we have only to watch the bending of the railway track under the wheels of a luggage train—in which a load of a couple of tons per wheel is something like the usual thing—in order to see that the depression thus produced in the solid mass of the track is much greater than 0·2 inches; consequently the experiment really demonstrates the exceptional solidity of the floor.

It is necessary to mention that changes of level of the order of magnitude of those produced in these experiments could not be detected by the spirit levels, and would have no sensible effect on the pendulum observations.

Fig 3.

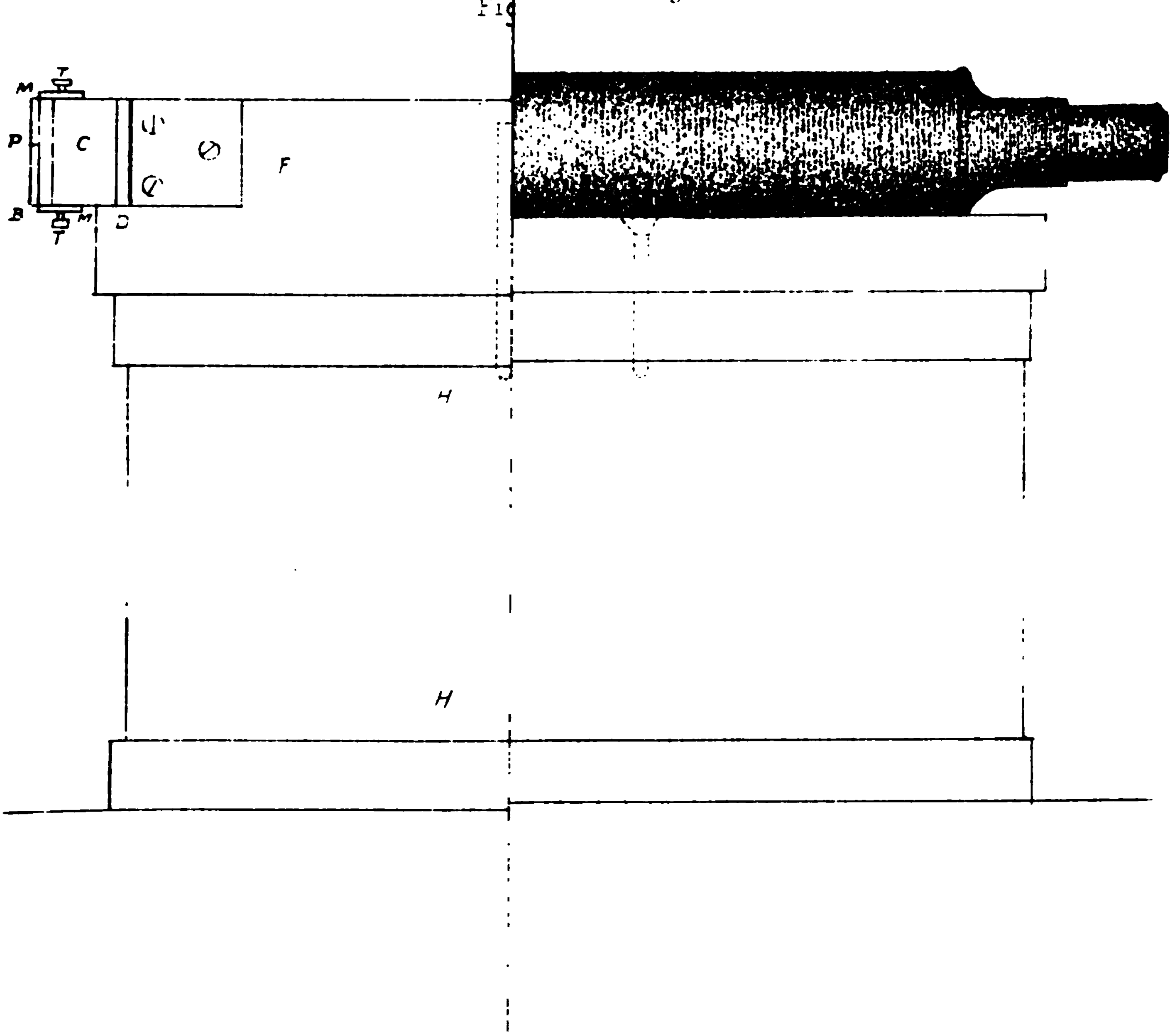
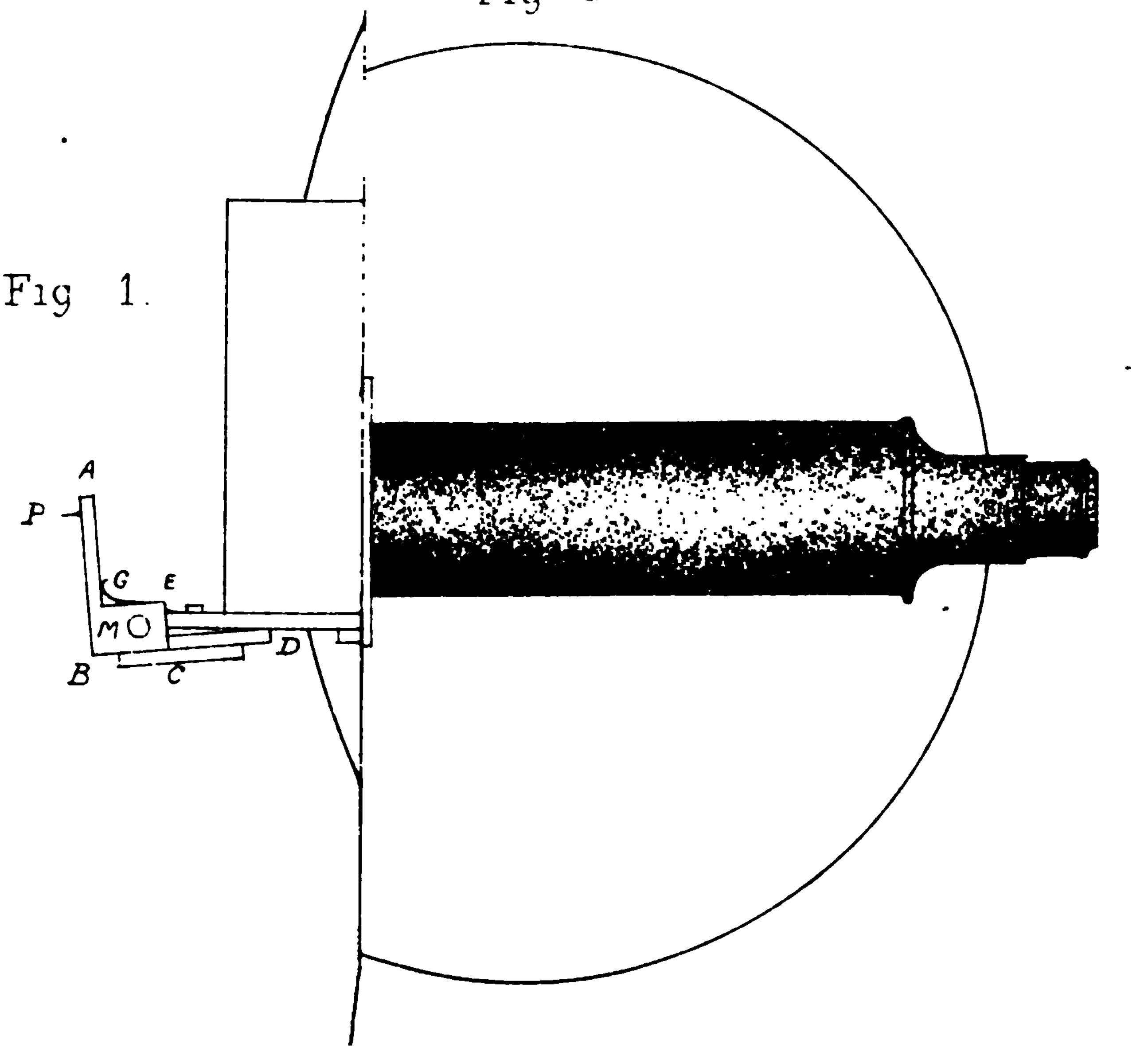



Fig 5

Fig 1.



## Art. II.—*Description of some Australian Birds' Eggs and Nests collected at Bloomfield, near Cooktown, Queensland.*

By D. Le Souëf.

[Communicated by Professor Baldwin Spencer.]

[Read 8th March, 1894.]

### Crescent-marked Oriole *(Mimeta flavo-cincta).*

These birds were occasionally seen in the open country, and I found their open nest on 3rd November, and secured the parent birds; it was suspended from a fork near the end of a thin bough of a Melaleuca tree, about forty feet from the ground, and difficult to get at. It contained two eggs on the point of hatching.

The tree was growing beside a waterhole, and a Quoy's crow-shrike had its nest in an adjoining tree. The nest is very similar in appearance to that of a Friar bird, and is outwardly composed entirely of strips of bark off a small species of Eucalyptus which grows in damp localities; the inside of the structure is lined with tendrils from the creepers in the scrub, which was about 300 yards away, it measures externally seven inches in length by five inches broad, with a depth of four and a quarter inches, and internal measurement three and three-quarter inches long by two and three-quarter inches broad, and three inches in depth. The eggs are nearly oval in form and of a pinkish-white colour, with a few rounded markings of a dark brown colour, especially towards the larger end. There are also some light grey markings, which have the appearance of being under the surface of the shell. They measure $A\ \frac{20}{16} \times \frac{14\frac{1}{2}}{16}$ inch $B\ \frac{22}{16} \times \frac{16}{16}$ inch.

This egg has not been described before.

### NORTHERN SPHECOTHERES (*Sphecotheres flaviventris*).

These birds were plentiful in the open country, and often seen in company with the Friar birds, the bright yellow markings on the breast of the male making him conspicuous.

We noticed them building on a small white gum tree on 18th October, and, going to the tree again on 25th October, found five of their nests on the tree, and also one of the silvery-crowned leatherhead; they were all built near the end of thin boughs, and only one could be got at by our native climber. We could see from below how many eggs were in each nest, the full clutch being three. Our blackfellow had a long thin stick, and, the nests he could not get at, he rolled the eggs out of one by one, and I caught them all uninjured in my hat as they fell. The nests were built of vine tendrils and small twigs, cup-shaped, and rather shallow, and, as before stated, could easily be seen through from below. The one I took measures externally five inches in diameter by three inches in depth, internal diameter three and a quarter inches by one and three-quarter inches in depth. The eggs are of a greenish-grey colour, with various sized irregular markings of a brown colour, with other fainter markings of a purplish hue, they both predominate towards the larger end, the eggs are nearly oval, tapering at the smaller end and measure $A\ \frac{20\frac{1}{2}}{16} \times \frac{15}{16}$ inch $B\ \frac{20}{16} \times \frac{15}{16}$ inch $C\ \frac{21}{16} \times \frac{15}{16}$ inch.

This egg has not been described before.

### CAT-BIRD (*Ailuredus maculosus*).

The curious harsh note of this bird was often heard in the scrub and several nests found; they seem to prefer building near the top of a slender tree, about fifteen feet from the ground, although on one occasion we found one within two feet, built on a creeper, but that was an exception; the structure is bulky and composed principally of leaves and twigs, mixed with fine rootlets and lined with finer tendrils, the external diameter of one I took is nine inches, and four and a half inches in depth, internal diameter five and three-quarter inches, and depth two

inches, but they vary in size; the eggs are two in number, and of a pale cream colour and glossy. One pair taken on 27th October measures $A\ \frac{27}{16} \times \frac{18\frac{1}{2}}{16}$ inch $B\ \frac{28}{16} \times \frac{19\frac{1}{2}}{16}$ inch.

### Coach-whip Bird (*Psophodes crepitans*).

The call of this bird was occasionally heard in the dense scrub on the higher lands, but the bird itself was seldom seen, it does not appear to be as large as our Victorian one, and it utters a slightly different note, its eggs also are smaller and of a lighter colour. We found its nest on 25th October with two eggs in, built in a thick mass of creepers about three feet from the ground, it was composed chiefly of vine tendrils and small twigs, the ground colour of the eggs was bluish-white, with irregular black markings, slightly more numerous at the larger end, there are also similar markings of a greyish colour appearing as if under the shell, they taper gradually towards the smaller end and measures $A\ \frac{18}{16} \times \frac{13\frac{1}{4}}{16}$ inch $B\ \frac{19}{16} \times \frac{13}{16}$ inch.

### Black-fronted Flycatcher (*Monarcha trivirgata*).

These flycatchers were seen only in the scrub, and were very shy birds. All the nests we found were built near the top of slender young trees, about four feet from the ground, and always near a watercourse; their pretty cup-shaped nests were, comparatively speaking, easily seen, they were outwardly composed of fine shreds of bark, pieces of skeleton leaves, a little moss, and all round the nests were fastened pieces of white spider cocoons, and a few of the softer green coloured cocoons made by other varieties of spiders. It gave the nests a curious appearance. All the inside was lined with very fine black rootlets and tendrils, having the appearance of horsehair, its external diameter is two and three-quarter inches by three and three-quarter inches in depth. Two eggs were always found in the nests on different dates in October, and the eggs in various stages of incubation. The eggs have a white ground colour, and are minutely speckled over with reddish-brown spots, which are very much more numerous at the larger end. A pair I took on 28th October measured $A\ \frac{14}{16} \times \frac{10}{16}$ inch $B\ \frac{14}{16} \times \frac{10}{16}$ inch.

QUEEN VICTORIA RIFLE BIRD *(Ptilorhis victoriæ).*

These birds were plentiful in the scrub, and their harsh note often heard, but the birds themselves generally kept out of sight, although they are by no means shy. We were fortunate in securing their nest on 29th October, built in a fan palm not far from the ground, and it contained two eggs, which seems to be a full clutch, another nest was being built in a Cordyline, only eight feet from the ground, when I left, and the eggs taken on 20th November. The nests vary in size, and are very loosely put together, consequently are built either in some thick creeper, or in a fan or other palm, and built close to the trunk and held up by the butt of the stem of the leaf; the hen bird, when sitting on her nest, is not easily disturbed. The external diameter of the nest found on the fan palm was six inches by three and a half inches in depth, internal diameter three and three-quarter inches by two inches in depth, and was composed almost entirely of vine tendrils. These birds often work pieces of the cast skins of snakes into their nests; I saw a piece, on one occasion, three feet long, most of which was hanging down loose. The two eggs were beautifully marked, having a reddish-cream ground colour, and irregular sized streaks of different shades of brown, commencing at the larger end and tapering off to a point, some of the streaks, which are more numerous at the larger end of the egg, are very short, others again continue three-quarters of the way down the surface of the egg and are broader than the short ones; the eggs, which are nearly oval in shape, have a beautiful gloss on them and measure $A\ \frac{21}{16} \times \frac{15\frac{1}{2}}{16}$ inch $B\ \frac{21}{16} \times \frac{15}{16}$ inch.

SUPERB FRUIT PIGEON *(Ptilinopus superbus).*

This beautiful little pigeon was seen on several occasions in the scrub, and we found several of their nests, each with a single egg in, and also secured the parent bird. They seem to prefer building on the higher part of the ranges. We found one nest, with a young one in, built in a small shrub about two feet from the ground, another on 27th October on a small bush which was growing some two feet out of the crevice of a rock overhanging a precipice, and it was with some difficulty that I managed to

secure the egg, others again from eight to ten feet from the ground in small trees. The nest measures three inches in diameter, and is composed of very few twigs. The egg is oval in form, and the one I got on the date before mentioned measures $\frac{22}{16} \times \frac{14\frac{1}{2}}{16}$ inch.

### Allied Fruit Pigeon (*Carpophaga assimilis.*)

These large pigeons were far more often heard than seen in the leafy tops of the dense scrub as they fed on the fruit, and frequently on passing underneath the high fruit-bearing trees, we heard the fruit dropping on the ground, showing the pigeons were busy overhead feeding, and we had to look a long time before we could make them out, their green colour making them more difficult to detect. Their nests, which were four inches in diameter, and built of small twigs, were found on several occasions, generally on a thin branch of a small tree some ten to fifteen feet from the ground, and frequently in trees overhanging streams ; only one egg was found in each nest. The three I have were taken on 23rd and 27th October, and 3rd November, and measure $A\ \frac{24}{16} \times \frac{17}{16}$ inch $B\ \frac{26}{16} \times \frac{17}{16}$ inch $C\ \frac{25\frac{1}{2}}{16} \times \frac{17}{16}$ inch.

### Ewing's Fruit Pigeon (*Ptilinopus ewingii*).

This beautiful little pigeon was seen in the scrub on the higher land near Bloomfield, but specimens were difficult to secure in the thick vegetation. We were fortunate in finding two of their nests on 24th October, one on the banks of the Annan River, in a small tree about eight feet from the ground, it contained a young bird newly hatched, and the hen bird let us approach within three feet of her nest before she flew off. The other nest was placed in a somewhat similar situation, and contained one fresh egg. They were unusually lightly built, with a few small sticks, and two and a half inches in diameter, and it looked as if the egg could hardly remain on when the bird was off the nest, the egg which is oval in form, and white, measures $\frac{20}{16} \times \frac{13\frac{1}{4}}{16}$ inch.

This egg has not been described before.

LONG-BILLED GREEN PIGEON (*Chalcophaps longirostris*).

This bird inhabits the northern portion of Australia, and its habits are very similar to its southern ally *Chalcophaps chryso-chlora.*

It is generally to be found on the ground and near streams in the shade of the thick vegetation. We only succeeded in finding one nest and one egg, and that on 5th November, and secured the parent bird. The structure was very lightly built, and not more than ten feet from the ground, and was placed near the end of a thin bough; the egg is white, and measures $\frac{18}{16} \times \frac{13\frac{1}{2}}{16}$ inch.

This egg has not been described before.

YELLOW-BELLIED FLYCATCHER (*Micrœca flavigaster*), Gould.

This little bird is found in the northern portions of Australia, generally in the open forest country and is fairly plentiful, its cheery note being often heard.

Its beautiful little nest, one of the smallest of Australian birds' nests, was found at Bloomfield, near Cooktown, on 25th October, 1893, and I secured the parent birds. It was built on the dead upper branches of a small tree, about fifteen feet from the ground, and contained one partially incubated egg; there was, apparently, no room for another. It was cup-shaped, the outside being covered with small pieces of bark fastened on with cobwebs at the upper end and hanging, being similar in colour to the bough on which it is built, making it very difficult to detect. Cobwebs are also wound round the nest over the bark, and also round the branch, as if to make the nest more secure; the rest of the structure is composed of fine shreds of bark and grass, very compactly put together. It measures externally one and a half inches in diameter, by three-quarters of an inch in depth, and internal diameter one and a quarter inches by half inch in depth.

The egg is a greyish-white ground colour, spotted with irregular shaped markings of various shades of brown, with underlying markings of grey, especially towards the larger end. It measures $\frac{13}{16} \times \frac{9}{16}$ inch.

This egg has not been described before.

[APPENDIX.]

## *Notes on a new species of Arses or Flycatcher.*

By A. J. CAMPBELL, F.L.S.

It is with pleasure I have to record an addition (a new species) to the list of Australian avi-fauna. During a successful collecting trip to Northern Queensland, Mr. Dudley Le Souëf, Assistant-Director Zoological Gardens, Melbourne, returned with many specimens of Natural history, new to science, amongst which there appeared a Fycatcher, evidently of the genus *Arses*, founded by Lesson. This genus of exceedingly elegant birds, mostly in simple black and white garb, embraces five hitherto known species—four confined to the New Guinea region, and one to Northern Queensland. The sixth species, or last discovered one, differs from the other Queensland bird in possessing a frill or colour upon the back of the neck, and agàin differs from the other Frilled-necked Flycatchers of the New Guinea region, by having a broad band of black across the breast, but resembles most of all the Little Frilled-neck Flycatcher (*A. aurensis*, Sharpe).

The new species was discovered by Mr. Le Souëf last November (1893), on the Bloomfield River about fifty miles south of Cooktown, Northern Queensland. Mr. Le Souëf informs me that the bird is peculiarly a denison of the thick palm scrubs. Its movements are graceful, and the white frill, which appeared to be erect, imparts a singular appearance to the bird, and serves to at once arrest the eye of the observer. Mr. Le Souëf thought its actions somewhat resembled those of the Tree-creeper (*Climacteris*), especially in its mode of ascending the under side of holes of trees and of scrub in search of insect prey—its chief food. Mr. Le Souëf only saw one pair in addition to a few single birds, which were observed either in the morning or towards evening.

I have proposed the name *Arses terræ-reginæ* for this new species, which may be known on the vernacular list as Le Souëf's

Frilled-necked Flycatcher. In connecting the discoverer's name with this interesting bird, I deem it an honour due to him for his indomitable perseverance and diligence as a field naturalist. Moreover, the name of Le Souëf (in part connection with his father, Mr. A. C. Le Souëf) is a household word amongst field workers and zoological institutions in Australia.

I exhibit here to-night, for comparison, the two Australian *Arses*, namely, *kaupi* and *terræ-reginæ*. During my own excursion to Northern Queensland, 1885, I secured a pair of Kaup's Flycatchers in the Cardwell Scrub. The one exhibited is the female, now in possession of our local taxidermist, Mr. A. Coles; the other was taken over by the the National Museum.

*Arses terræ-reginæ*, Campbell.

*Male.*—Head, including ear coverts and side of face, velvety black. Upper part of back, shoulders, broad band across the breast, glossy or bluish-black. Wings, except where blending into a brownish shade at the primaries, and tail, black. Tibial plumes, dusky. Surrounding the back of the neck is a pure white frill or collar joining a white throat and chin. Abdomen, part of under wing coverts, and lower portion of the back also white. In the specimen under consideration there appears some patches of parti-colour on the back, indicating possibly that the bird has not reached mature plumage. In life a narrow disc of beautiful bluish wattle surrounds the eyes, which are dark brown. Bill (narrow) steel-blue; feet black. Total length, 6·3 inches; bill (from gape), ·75; culmen, ·4; wing, 3·25; tail, 3·; tarsus, ·73.

*Female.*—Judging by analogy, probably resembles those of the other frilled-necked species, in being generally dusky brown or rufous in colour.

# Art. III.—*Notes on some Lancefield Graptolites.*

By G. B. Pritchard.

[Read 8th March, 1894.]

In the Proceedings of this Society for the year 1891, Mr. T. S. Hall, M.A., described a new species of *Dictyonema* under the name of *D. grande*. Since the publication of that paper I have been fortunate enough to obtain among some additional examples of the species, an exceptionally perfect and well-preserved specimen, with the hydrothecæ well developed and clearly discernible. Mr. G. Clark, who accompanied me on the occasion of obtaining this prize, kindly drew my attention to a small exposure of the free branches of the polyp-stock on a face of the outcrop, and by exerting a little care I was able to secure both sides of a perfectly entire specimen. I take this opportunity of thanking Mr. Clark for his kindness in so readily handing over his right to this specimen.

## Genus Dictyonema, Hall.

*Dictyonema*, though it has been very often placed among the Graptolites, strictly speaking does not belong to them, as the very characteristic chitinous supporting rod of that group is absent. Professor Nicholson* regards *Dictyonema* as probably an early type of the Order *Thecaphora* of which *Sertularia* and *Campanularia* are living representatives. Zittel† appears to hold the same view, as he places it in the Sub-order *Campanulariæ.*

The genus was originally founded by Professor J. Hall‡ in the following language:—"Fronds consisting of flabelliform or funnel-shaped expansions (circular from compression), composed of slender radiating branches, which frequently bifurcate as they recede from the base. Branches and subdivisions united laterally by fine transverse dissepiments; exterior of branches

* Manual of Palæontology, vol. i., p. 204.

† Handbuch der Palæontologie, Band I., p. 289.

‡ Palæontology of New York, vol. ii, p. 174, 1852.

strongly striated and often deeply indented; inner surface celluliferous or serrate, as in Graptolithus." Although Professor Hall indicates the occurrence of hydrothecæ in the above description, it does not seem to me absolutely clear whether the whole frond bears hydrothecæ or only a portion of it. Judging from the specific descriptions, specimens with the hydrothecæ preserved must have been very rare indeed, as the majority of the species which have come under my notice have been incomplete in this respect.

Zittel* gives the following definition:—"Hydrosome, funnel pannier or fan-shaped, with numerous branches almost parallel, strong, forked and united by cross-threads. The ends of the branches are free, and are then set on one side with pointed hydrothecæ. The latter appear very perishable, and are exceedingly seldom preserved." In this definition it is apparently intended to indicate that only the free ends of the branches bear hydrothecæ. In the specimen now before me the hydrothecæ occur not only on the free ends of the branches, but are also plainly seen on other parts of the frond, and I have been able to trace them almost to the very centre of the polyp-stock.

Mr. T. S. Hall remarks in connection with the description of his species,† that "the diameter of a perfect specimen has not yet been determined, and the hydrothecæ are not visible in any of the specimens." I will therefore avail myself of this opportunity to add the following observations to complete the diagnosis of—

DICTYONEMA GRANDE, T. S. Hall.

The branches where the hydrothecæ are well-developed are from 2·5 mm. to 3 mm. broad. Hydrothecæ long, narrow, mucronate, indent the branches for about one-third the width, free for about one-fifth their length; length 5 mm., breadth of aperture 1 mm., but gradually narrowing towards the back of the branch. The upper margin or aperture is decidedly concave; the lower margin is straight, can be traced to a point opposite the aperture of the third lower hydrotheca, and makes an angle of about 15° with the back of the branch; the mucronate point is set at about twice that angle, which gives a somewhat arched

* Handb. d. Pal., Band I., p. 289.

† Proc. Roy. Soc. Vict., vol. iv., N.S., pt. I., p. 8.

aspect to the upper portion of the lower margin. Hydrothecæ number ten to the centimetre. Breadth of the entire stock, from 24 cm. to about 30 cm.

GENUS TEMNOGRAPTUS, Nicholson.

In 1891 I described a gigantic graptolite under the name *Temnograptus magnificus*, and drew attention to the close relation which undoubtedly existed between it and *T. multiplex*, Nicholson, the type of the genus, and three other species originally described by Professor J. Hall as *Graptolithus flexilis*, *G. rigidus*, and *G. abnormis*. The three last-named species are now regarded as belonging to the genus *Clonograptus*, and according to Dr. O. Herrmann in a paper on the *Dichograptidæ** *T. multiplex*, Nicholson, must also be referred to this genus, as he asserts that *Temnograptus* is not sufficiently distinct from *Clonograptus*. However, in a communication I received from Professor Nicholson he informs me that he is not at all disposed to regard these two genera as identical, also that he regards my species as doubtless congeneric with his *T. multiplex*. I will therefore for the present allow the generic location of my species to stand unaltered.

GENUS CLONOGRAPTUS, Hall.

"Hydrosome bilaterally sub-symmetrical, consisting of more than four simple branches produced by dichotomous division. The spaces between the furcation-points are larger than in *Dichograptus*. Central disc never present."

CLONOGRAPTUS FLEXILIS, Hall.

*Graptolithus flexilis*, Hall, Geological Survey of Canada Report for 1857, p. 119; also Graptolites of the Quebec Group, p. 103, pl. x., figs. 3-9.

*Description.*—Polyp-stock multibrachiate, composed of numerous slender branching stipes symmetrically disposed on the two sides of their origin. Sicula, minute; funicle, short, from 1·5 mm. to 2·5 mm. in length, dividing at the extremities at an angle of about 105°; each of these four branches again divides within the space of from 2·5 mm. to 5 mm., making eight principal

* Geo. Mag., N.S., Dec. III., vol. iii., No. 1, p. 25.

branches, which are again several times bifurcated. Hydrothecæ commence above the third bifurcation, that is taking the division of the sicula into two branches, which form the funicle, as the first bifurcation. Stipes slender, flexuous, diverging at a smaller angle at each successive bifurcation; filiform at base, and, where the hydrothecæ are developed, measure from 1 mm. to 1·75 mm. The non-hydrothecal-bearing stipes measure about ·5 mm. in width. In the entire stock there are six bifurcations, giving rise to sixty-four branchlets in all. Breadth of the entire stock about 9 c.m.

Hydrothecæ, short and acute, indent the branches for one-half the width, and are free for nearly one-half their length; length being about four times their diameter; aperture or upper margin, straight, making an angle of 90° with the axis, lower margin straight and inclined to the axis at about 30°. Hydrothecæ number from ten to eleven to the centimetre.

*Obs.*—In some of the Lancefield specimens the angle at which the parts of the divided extremities of the funicle diverge is a little greater than that mentioned above, being 112° in the specimens under notice; also the length of the four main stipes is from ·5 to 2·5 mm. longer in some examples. The hydrothecæ agree well with the original description. On the whole, the agreement of Lancefield specimens with the American is remarkably close and accurate.

This is, I believe, the first record of the occurrence of this species in Victoria, and is all the more interesting on that account, as it is another example of the wide distribution of Graptolite species.

### TETRAGRAPTUS QUADRIBRACHIATUS, Hall.

This species occurs rather commonly associated with the previously described forms from this locality. It is generally somewhat small, and the hydrothecæ are often not preserved, but occasionally a well-developed specimen has turned up with stipes quite two and one-half inches in length.

In addition to the above, I have a new species of *Dictyonema*, *Didymograptus* represented by, at least, one species, *Tetragraptus*, probably two forms, *Leptograptus*, also two forms, and another species of *Clonograptus*. Notes on these I hope to be able to add on some future occasion.

# ART. IV.—*Note on the presence of Peripatus insignis in Tasmania.*

By BALDWIN SPENCER,

Professor of Biology in the University of Melbourne.

[Read 8th March, 1894.]

Up to the present time the only record of Peripatus from Tasmania is that of a single specimen described by Mr. J. J. Fletcher.

On the continent of Australia at any rate two, and possibly three, species exist. There are *P. leuckartii*, *P. insignis* and a Victorian form as yet referred to the former species, but which may possibly turn out to be distinct.

In Victoria *Peripatus* has never yet been found in such abundance as Mr. Fletcher has recently described in the case of the New South Wales form, *P. leuckartii*, from the Blue Mountains, and of our two species the one first described by Dr. Dendy as *P. insignis* is comparatively rare.

Whilst in Tasmania during the summer of 1893 I searched hard for *Peripatus* on Mount Wellington, in the Lake St. Clair district, around Dee Bridge and Parattah. Though the localities were apparently favourable ones I only succeeded in finding it at Dee Bridge, where, under fallen logs and within the space of half an acre I found some fifteen specimens.

The interest of these lies in the fact that they are all referable to the species *P. insignis*, with which they agree in the absence of the accessory tooth on the outer jaw, in the possession of fourteen pair of legs, and, generally speaking, in colouration. Just as in the case of *P. leuckartii* there is a wide range of variation in colouration, from very dark purplish-black specimens, in which only the rudiments of a skin pattern can be detected, to others in which the latter is a very marked feature.

A point to notice is the large size of the specimens as compared with those of the mainland—a feature not infrequent in the case

of other forms of life common to Tasmania and the continent. Those described by Dr. Dendy from Victoria measured, after preservation in spirits, about eleven millimetres in length, and one millimetre in greatest breadth. Of the Tasmanian form (killed by drowning and subsequent preservation in spirit), three of the largest measure, respectively, twenty-three, seventeen and fifteen millimetres in length (exclusive of tentacles), and four, three, and three millimetres in breadth, whilst the smaller ones, evidently immature, measure eleven millimetres in length, and one millimetre in breadth.

It is again worthy of note that just as in the case of many other forms so in that of Peripatus we find an alliance between the S.E. part of Australia and Tasmania.

I may add that in the same localities—St. Clair, Dee Bridge, and Parattah, I also found considerable numbers of the land Nemertine—*Geonemertes australiensis*—of which only one specimen has hitherto been recorded from Tasmania.

ART. V.—*Preliminary Notes on Tasmanian Earthworms.*

(With Plates I., II., III., IV. and V.)

BY BALDWIN SPENCER,

Professor of Biology in the University of Melbourne.

[Read 8th March, 1894.]

In two previous communications to this Society I have described as preliminary to a joint work by Mr. Fletcher of Sydney and myself on the Earthworm fauna of Australia the species of Megascolides, Cryptodrilus and Perichæta which had up to the date of publication been found in Victoria. This evening I describe a series of Earthworms from Tasmania, and I have to thank Mr. A. Simson, of Launceston, Mr. A. Morton, of the Tasmanian Museum, and Mr. C. G. Officer, B.Sc., of the Melbourne University, for valuable assistance in collecting. To Mr. Morton I am indebted for several forms, and especially for specimens of the large *Megascolides tasmanianus*, described by Mr. J. J. Fletcher. My own collecting has been done on Mount Wellington, around Dee Bridge, amongst the mountains in the Lake St. Clair district, around Parattah, and to a small extent along the north coast in the neighbourhood of Table Cape and Emu Bay. A visit of the Field Naturalists' Club of Victoria to King Island, enabled me to collect one or two forms in this spot half-way between the continent and Tasmania. The search has not yielded so many forms as I had hoped and expected to find, a result which may possibly be due to the fact that it has been carried on during the summer, but Mr. Officer informs me that earthworms were much more numerous along the King River Valley amongst the western mountain ranges, than in the region of Lake St. Clair, where we were camped out for some four weeks in the early part of 1893.

The same three genera to which our Australian species are provisionally referred are all represented in Tasmania, and to

these genera the Tasmanian forms are likewise provisionally referred, though, as previously stated, it will be necessary to revise the classification when the collections of Mr. Fletcher and myself are sufficiently complete and described.

Up to the present time only a single earthworm is described from Tasmania, viz., *M. tasmanianus, Fl.*

The collection here described consists of 10 species of Cryptodrilus, 2 species of Megascolides, 6 species of Perichæta, all new to science, so that together with Mr. Fletcher's *M. tasmanianus* we now know of the existence of 19 species of earthworms in Tasmania. There must be very many yet undiscovered, especially in the well-watered valleys on the west coast of the island, but so far as yet known the earthworm fauna is not so extensive as that of Victoria or New South Wales.

The following account does not include the description of species which have clearly been introduced from foreign countries.

### (*a*) Cryptodrilus, Fletcher.

(1). *C. irregularis*, sp. n. (Figs. 1, 2, 3). Spirit specimen, 6 inches long, more than $\frac{1}{8}$ inch broad.

Prostomium about half dovetailed into the peristomium.

Clitellum not at all prominent, indicated by darker colour in spirit specimen, and including segments 14-17 and the posterior part of segment 13.

Setæ regularly arranged only so far back as the fourteenth segment, after which they become very irregular and give a decidedly perichæte appearance to the body, though more than four do not appear to be present on each side.

Male pores difficult to determine. There is a ventral median patch on segment 18 of a white tumid nature, and on this the two openings lie either very close together or fused so as to form a single one.

Oviduct pores on segment 14. Ventral of and anterior to the innermost seta of each side.

Spermathecal pores, two in number, at the level of the innermost seta of each side. One between segments 7 and 8, the other between segments 8 and 9.

Dorsal pores present, the first between segments 4 and 5.

Nephridiopores not discernible.

Alimentary Canal. Gizzard in segment 5. There are vascular swellings on the oesophagus in segments 9-13, that in segment 13 being especially strongly developed, but it is not nipped off like a true calciferous gland. Large intestine commencing in segment 18.

Blood vascular system. Single dorsal blood vessel with hearts, the last of which is in segment 12. Supra-intestinal vessel in segments 8-12.

Excretory system. Plectonephric with no large nephridia.

Reproductive system. Testes, two pairs in segments 10 and 11, ciliated rosettes in the same segments.

Prostates flattened, racemose in segment 18.

Sperm sacs, saccular and attached to the anterior wall of segment 12.

Ovaries attached to the anterior wall of segment 13, oviducts open into the same segment.

Spermathecæ, two pairs, in segments 8 and 9. Diverticulum not quite half as long as the sac, both being simple in outline.

Habitat. Table Cape, Tasmania, under logs.

(2). *C. polynephricus* (Figs. 4, 5, 6). Length in spirit 5-6 inches. One quarter inch broad.

Prostomium about one half dovetailed into the peristomium. Clitellum distinct, and when fully formed complete, occupying segments 13-17. When not fully formed is incomplete ventrally, and somewhat saddle-shaped. Tumid.

Setæ, four couples regularly arranged. The two inner ones on each side near together, the two outer ones widely apart, the interval between them being twice as great as that which separates the two most dorsal ones. The dorsal and ventral intervals, and that between the second and third setæ of each side are about equal.

Male pores on segment 18 between the level of the two inner setæ on each side.

Oviduct pores on segment 14 ventral of, and anterior to, the level of the innermost setæ.

Spermathecal pores, two in number, on the anterior faces of segments 8 and 9, just dorsal to the level of the innermost setæ. On white elliptical patches.

Accessory copulatory structures. Three pairs of elliptical tumid patches on segments 9, 10 and 11, each placed at the posterior end of the segment at the level of the second setæ. Dorsal pores not visible.

Nephridiopores 10 in each segment. One just in front of each seta, and one between setæ 3 and 4 on each side.

Alimentary canal. Gizzard in segment 5. No true calciferous glands. Large intestine commencing in segment 17.

Excretory system. Five nephridia on each side in each segment, corresponding in position to the setæ, with an extra one between the third and fourth setæ. No ciliated funnels discernible.

Reproductive organs. Testes, two pairs, one in segment 10, another in segment 11. Rosettes in the same segments.

Prostates, large, tubular, somewhat coiled. Extending through segments 18-21.

Sperm sacs, racemose on the anterior septum of segment 12, and the posterior of segment 9.

Ovaries in segment 13. Oviducts opening into the same segment.

Spermathecæ, two pairs, each with a simple diverticulum about one-quarter the length of the sac.

Circulatory system. Single dorsal vessel. Hearts in segments 4-13. In segments 4-9 are small and arise from the dorsal vessel, in segments 9-13 large, and arise from the supra-intestinal vessel which extends through segments 9-13.

Habitat. Mount Wellington, Hobart, and Parattah, Tasmania.

(3). *C. mortoni.* Length in spirits, 2½-3 inches, one-quarter inch broad. In spirit the worm is a flesh colour, and broad in comparison to its length. (Figs. 7, 8, 9).

Prostomium completely dovetailed into the peristomium. Clitellum well marked, extending over segments 14-17, somewhat darker than the rest of the body in spirit specimens. Tumid.

Setæ regularly arranged in four couples, the intervals between the two couples nearly equal and slightly greater than that between setæ 2 and 3.

Male pores on papillæ on segment 18 just dorsal to the level of the innermost setæ.

Oviduct pores on segment 14.

Spermathecal pores, five in number at the intervals between segments 5 and 6, 6 and 7, 7 and 8, 8 and 9, 9 and 10. Indicated by white glandular spots just dorsal to the level of the innermost setæ.

Accessory copulatory structures. An elliptical tumid patch in the median ventral space between segments 17 and 18; other patches at the level of the second setæ of each side on segment 17 and between segments 18 and 19 and 19 and 20 at the level of the first setæ. The two latter extend inwards near to the mid-ventral line.

Dorsal pores present, the first between segments 4 and 5.

Nephridiopores at the level of the third seta on each side.

Alimentary canal. Gizzard in segment 5. True calciferous glands present in segments 13-16. Large intestine commencing in segment 18.

Excretory system. Meganephric.

Reproductive system. Testes in segments 10 and 11. Ciliated rosettes in segments 10 and 11.

Sperm sacs, racemose, attached to the anterior wall of segment 12.

Ovary in segment 13. Oviducts opening into the same segment.

Spermathecæ, 5 pairs, one each in segments 5-9, with a small simple diverticulum less than one-half the length of the sac.

Habitat. Dee Bridge and Mount Wellington, Tasmania. Under logs and stones. I have pleasure in associating with this the name of Mr. A. Morton, Curator of the Hobart Museum, and Secretary of the Royal Society of Tasmania, to whom I am indebted for help in various ways.

(4). *C. hobartensis* (Figs. 10, 11, 12). Length in spirits 3 inches, slightly more than ⅛ inch broad. The dorsal surface is purple, the ventral is flesh coloured, and the clitellum lighter than the surrounding parts. The setæ are distinct. There is a median dorsal dark line extending on to the prostomium.

Prostomium dovetailed about one half into the peristomium.

Clitellum distinct, tumid, complete occupying segments 14-16 together with the posterior part of 13, and the anterior part of 17.

Setæ in four couples, the two of the ventral couple being nearer to each other than tho two of the outer. The fourth seta on each side is near to the dorsal surface.

Males pores on papillæ at the level of the interval between the two inner setæ on segment 18.

Oviduct pores on segment 14.

Spermathecal pores, five pairs at the level of the first setæ between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9.

Dorsal pores, present, the first between segments 4 and 5.

Accessory copulatory structures. Four pairs of elliptical patches at the level of the interval between the first and second setæ between segments 16 and 17, 17 and 18, 18 and 19, 19 and 20.

Alimentary canal. Gizzard in segment 5. The calciferous glands in segments 12, 13, 14 and 15. Large intestine commencing in segment 17.

Circulatory system. Single dorsal vessel. The last pair of hearts in segment 12.

Excretory system. Meganephric.

Reproductive system. Testes, two pairs, in segments 10 pan 11 into which also open the rosettes.

Prostates. Long, widely tubular and coiled, extending through segments 18-24.

Ovaries in segment 13, into which the oviducts also open.

Spermathecæ, five pairs, in segments 5, 6, 7, 8 and 9. The diverticulum simple and not more than half the length of the sac.

Sperm sacs, racemose in segments 9 and 12.

Habitat. Parattah and Mount Wellington.

In internal anatomy this worm is almost identical with *C. mortoni*, but the two are perfectly distinct in external appearance. The worm in question is a whitish stout form, whilst *C. mortoni* is darkly coloured with conspicuous setæ, and is long and narrow.

(5). *C. campestris* (Figs. 13, 14, 15). Length in spirits 2-3 inches, $\frac{1}{8}$ inch broad. Colour when alive whitish with pink clitellum, the same colour retained, only duller, in spirits.

Prostomium dovetailed about $\frac{1}{3}$ into the peristomium.

Clitellum distinct, tumid, occupying segments 13-17, but not the whole of 17 ventrally, so that at its posterior end it is slightly saddle-shaped.

Setæ in four couples, regularly arranged, the dorsal couple of each side being so close to the mid-dorsal line, that only a slight interval is left between the dorsalmost setæ of each side.

Male pores on large papillæ on segment 18, the pore being just within the level of the second seta.

Oviduct opening on segment 14.

Spermathecal pores, two, indicated by small white tumid patches just dorsal to the level of the innermost setæ between segments 7 and 8, 8 and 9.

Accessory copulatory structures. Two large circular patches on segment 17, two elliptical patches on segments 18 and 19, 19 and 20.

Dorsal pores present, the first between segments 3 and 4.

Nephridiopores not visible.

Alimentary canal. Gizzard in segment 5. No true calciferous glands. Large intestine commencing in segment 16. Glandular tufts (pepto-nephridia ?) connected with the alimentary canal in segment 4.

Circulatory system. Single dorsal blood-vessel with the last pair of hearts in segment 12. Sub-intestinal vessel from which in segments 10, 11 and 12 arise the hearts.

Excretory system. Plectonephric with no large nephridia.

Reproductive system. Testes, two pairs in segments 10 and 11 with ciliated rosettes in the same segments.

Prostates small and flattened in segment 18.

Sperm sacs, racemose, attached to the anterior wall of segment 12 and the posterior of segment 9.

Ovaries in segment 13 with oviducts opening into the same segment.

Spermathecæ, two pairs, one each in segments 8 and 9. The diverticulum is rosette-shaped, the sac simple.

Habitat. Parattah, Tasmania, in damp earth under logs.

(6). *C. tesselatus* (Figs. 16, 17, 18). Length in spirit 1 inch. Colouration of the body strongly marked both when alive and in spirits. The body is purplish with the setæ on small white elevations which give it a distinct chequered appearance. A mid-dorsal line runs right forward on to the prostomium. About 65 segments. The peristomium has a mid-ventral cleft.

Prostomium scarcely at all dovetailed into the peristomium.

Clitellum distinct, tumid and occupying segments 13-17 with a mid-ventral continuation including parts of segments 18 and 19 so far dorsal as the level of the second setæ on each side.

Setæ, 4 on each side, the dorsal row very irregular and may be wanting in a few segments, so that occasionally there are only 3 on each side. The third row is regular to within some 6 segments of the posterior end.

Male pores on small papillæ on segment 18 at the level of the interval between the two inner setæ on each side.

Oviduct pores on segment 14.

Spermathecal pores, two in number, at the level of the interval between the two inner setæ of each side, between segments 7 and 8, 8 and 9.

Accessory copulatory structures. Two pairs of small elliptical patches, at the level of the interval between the two inner setæ of each side, between segments 12 and 13, 13 and 14.

Dorsal pores present, the first between segments 5 and 6.

Nephridiopores not discernible.

Alimentary canal. Gizzard in segment 5. No true calciferous glands present. Large intestine commencing in segment 17.

Circulatory system. Single dorsal vessel. Last pair of hearts in segment 12. Supra-intestinal vessel present (?).

Excretory system. Meganephric.

Reproductive system. Testes, two pairs, in segments 10 and 11, into which the ciliated rosettes open.

Prostates, flattened, small, in segment 18.

Sperm sacs, attached to the anterior wall of segment 12, sacular in form.

Ovaries in segment 13, the oviducts opening into the same segment.

Spermathecæ, two pairs, one each in segments 8 and 9. The diverticulum is simple and less than one-half the length of the sac.

Habitat. Mount Olympus, Lake St. Clair, Tasmania, in damp soil under logs, and amongst decaying leaves in Beech Forest *(Fagus cunninghami).*

(7). *C. insularis* (Figs. 19, 20, 21). Length in spirit 1-2 inches, about $\frac{1}{8}$ inch broad. In spirit is dull purple colour dorsally, pinkish-purple laterally, and flesh colour ventrally.

Prostomium dovetailed about one half into the peristomium.

Clitellum distinct, including segments 14-16 and the anterior portion of segment 17, and the posterior of segment 13. Lighter in colour than surrounding segments.

Setæ regularly arranged save an odd one or two at the posterior end. The two innermost setæ of each side are drawn in towards the middle line in segments 17, 18 and 19, so that the inner couple lie close together on each side.

Male pores on white elliptical patches on segment 18 at the level of the interval between the inner couple of setæ on each side.

Oviduct pores on segment 14.

Spermathecal pores, five in number, placed at the level of the innermost setæ between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9.

Accessory copulatory structures. A pair of small elliptical patches at the level of the interval between the two inner setæ of each side, between segments 16 and 17.

Dorsal pores present, the first between segments 5 and 6.

Nephridiopores at the level of the third setæ, the openings indicated by a small white patch on the anterior margin of the segment.

Alimentary canal. Gizzard in segment 5. No true calciferous glands present. Large intestine commencing in segment 16.

Circulatory system. Single dorsal vessel. Hearts in segments 10, 11 and 12, larger than those in front and arising from the supra-intestinal vessel.

Excretory system. Meganephric.

Reproductive system. Testes in segments 10 and 11, ciliated rosettes in the same segments.

Prostates very long, extending through segments 18-27, tubular, coiled.

Sperm sacs, racemose, on the posterior face of segment 9 and the anterior of segment 12.

Ovaries in segment 13, into which also the oviducts open.

Spermathecæ, five pairs, in segments 5, 6, 7, 8 and 9. The diverticulum simple and about one-half the length of the sac.

Habitat. Parattah, Tasmania, under logs.

(8). *C. ellisii* (Figs. 22, 23, 24). Length in spirits 1-1½ inches about ⅛ inch broad. The dorsal surface (in spirits) is dark purple in front of the clitellar region, brown behind this, and dull flesh colour at the posterior end, the ventral surface throughout being lighter in colour than the dorsal. The clitellum is dull flesh colour.

Prostomium dovetailed one-half into the peristomium and marked by a median dorsal line which is continued down the body.

Clitellum distinct, tumid, lighter coloured than the surrounding parts and extending completely over segments 14-16. It may include the posterior part of segment 13.

Setæ in 4 couples regularly arranged. The two inner ones on either side nearer together than the two outer ones. The spaces between setæ 2 and 3, 3 and 4, and dorsally between seta 4 of each side being about equal.

Male pores on papillæ on segment 18, the pore being at the level of the second seta of each side or perhaps slightly ventral of this.

Oviduct pores on segment 14.

Spermathecal pores, three in number, on white elliptical patches at the level of the second setæ between segments 6 and 7, 7 and 8, 8 and 9.

Accessory copulatory structures. Two elliptical patches at the level between the two inner setæ of each side on the anterior faces of segments 10 and 11. Two pairs at the same level between segments 17 and 18, 18 and 19. Two pairs at the same level on the anterior margins of segments 20 and 21.

Dorsal pores present, the first between segments 5 and 6.

Alimentary canal. Gizzard in segment 5. Two pairs of calciferous glands present one each in segment 14 and segment 15. Large intestine commencing in segment 17.

Circulatory system. Single dorsal blood vessel. The last pair of hearts in segment 12.

Excretory system. Meganephric.

Reproductive system. Testes, two pairs, in segments 10 and 11 into which also open the ciliated rosettes.

Prostates tulular, coiled, occupying segments 17-20.

Sperm sacs, racemose, attached to the anterior face of segment 12 and the posterior of segment 9.

Ovaries in segment 13 into which the oviducts also open. Ovisacs (or additional ovary ?) in segment 14.

Spermathecæ, three pairs, in segments 7, 8 and 9. The diverticulum simple and small compared with the sac.

Habitat. Dee Bridge, Tasmania, under logs and stones.

(9). *C. wellingtonensis* (Figs. 25, 26, 27). Length in spirits a little less than 4 inches, ¼ inch broad.

Prostomium scarcely dovetailed at all into the peristomium.

Clitellum, tumid, well marked, occupying segments 14-17, and extending slightly into the dorsal surface of segment 18, and incomplete ventrally in the median part of segment 17.

Setæ, the inner couple close together, the dorsal couple not visible.

Male pores on a papilla on segment 18 at the level of the interval between the inner couple of setæ on each side.

Spermathecal pores, two pairs, on white elliptical patches on the anterior margins of segments 7 and 8, at the level of the interval between the two inner setæ of each side.

Accessory copulatory structures. Swollen, tumid ridges on segments 18, 19 and 20.

Dorsal pores present, the first between segments 3 and 4.

Nephridiopores not discernible.

Alimentary canal. Gizzard in segment 5. No true calciferous glands, but vascular swellings in segments 9-14. In segment 9 the canal is especially swollen and whitish in appearance. Large intestine commencing in segment 16.

Circulatory system. Single dorsal vessel. Hearts in segments 6-12, those in segments 9-12 larger than the rest, and connected with the supra-intestinal vessel.

Excretory system. Plectonephric, with no large nephridia.

Reproductive system. Testes, two pairs, in segments 10 and 11, the ciliated rosettes opening into the same segments.

Prostates, flattened, racemose surface, in segment 18.

Sperm sacs in segments 9 and 12; racemose.

Ovaries in segment 13 into which also the oviducts open.

Spermathecæ, two pairs, in segments 8 and 9. The diverticulum distinct and rosette shaped.

Habitat. Mount Wellington. Tasmania.

(10). *C. officeri* (Figs. 28, 29, 30). Length in spirit 1¾ inch, less than one-quarter inch broad. In spirit the body is a light violet colour dorsally, and flesh colour ventrally, the clitellum being darker than the rest.

Prostomium about three-quarters dovetailed into the peristomium.

Clitellum distinct, tumid, complete, extending over segments 14-17. Purple colour, except the mid-ventral surfaces of segments 15, 16 and 17 where it is light coloured.

Setæ in four couples. Irregular at the posterior end. About one-third of the way down the body the fourth row becomes irregular, then the third and at the very posterior end all four rows may be irregular, but the first and second are quite regular except during the last few segments.

Male pores on papillæ on segment 18, at the level of the second seta on each side.

Oviduct pores on segment 14.

Spermathecal pores, three pairs placed slightly dorsal to the level of the second row of setæ between segments 6 and 7, 7 and 8, 8 and 9.

Accessory copulatory structures. Elliptical patches at the level of the second row of setæ between segments 15 and 16, 16 and 17. A pair at the level of the interval between the two inner setæ between segments 19 and 20.

Dorsal pores present, the first between segments 4 and 5.

Nephridiopores not visible.

Alimentary canal. Gizzard well marked, but there are no distinct septa in front of that bounding segment 8 anteriorly. No true calciferous glands, but vascular swellings are present in segments 13-15. Large intestine commencing on segment 17.

Circulatory system. Single dorsal vessel. No continuous supra-intestinal. Hearts in segments 7-12.

Excretory system. Three nephridial tufts on each side of the body—resembling in this respect *C. fastigatus*, and *C. dubius*.

Reproductive system. Testes, two pairs, in segment 10 and 11, the ciliated rosettes opening into the same segment.

Prostates small, flattened, racemose, in segment 18.

Sperm sacs, racemose, in segments 9 and 12.

Ovaries in segment 13 into which the oviducts also open.

Spermathecæ, three pairs in segments 7, 8 and 9. The diverticulum in the form of a group of little finger-like processes, the sac long and irregular in outlines.

Habitat. King River Valley, Tasmania.

## (*b*) MEGASCOLIDES, McCoy.

(1). *Megascolides simsoni* (Figs. 31, 32, 33). Length in spirits 1¾ inches, ⅛ inch broad.

Prostomium very slightly dovetailed into the peristomium.

Clitellum complete including when fully grown segments 13-18.

Setæ in four couples. Those of the two inner couples considerably nearer together than those of the outer. The former are regularly arranged all the whole length, the latter become irregular about half-way down the body, though here and there an odd one may be irregular immediately behind the clitellum.

Male pores not very clearly marked on slight papillæ on segment 18 at the level of the innermost seta of each side.

Oviduct pores on segment 14.

Spermathecal pores, two pairs at the level of the innermost setæ between segments 7 and 8, 8 and 9.

Accessory copulatory structures. Two pairs of white elliptical patches at the level of the interval between the two inner setæ between segments 19 and 20, 20 and 21.

Dorsal pores present, the first between segments 4 and 5 (?).

Nephridiopores. A pore is present immediately in front of each seta, so that from the second segment backwards there are eight nephridiopores in each segment, though occasionally one or more on each side may not be visible. In the clitellar region apparently there may be more than eight in each segment.

Alimentary canal. Gizzard in segment 5. No true calciferous glands, but vascular swellings are present in segments 9-16. Large intestine commencing in segment 19.

Circulatory system. Single dorsal vessel. Hearts in segments 8-13, through which also runs a supra-intestinal vessel.

Excretory system. Some four meganephridia (?) in each segment but no funnels visible. Behind the clitellar region sac-like structures lie dorsally and tufts of coiled tubes in two or three rows lie ventral of them and correspond apparently in position to the nephridiopores externally.

Reproductive system. Testes in segments 10 and 11 into which also the rosettes open.

Prostates, small, flattened, and slightly racemose, in segment 18.

Sperm sacs, racemose in segments 11 and 12 attached to the anterior walls.

Ovaries in segment 13 into which the oviducts open.

Spermathecæ, two pairs, in segments 8 and 9. Diverticulum simple and small compared with the sac.

Habitat. Emu Bay and Launceston, Tasmania. This form is associated specifically with the name of Mr. A. Simson, of Launceston, to whose kindness I am indebted for specimens of Tasmanian forms.

(2). *M. bassanus* (Figs. 34, 35, 36). Length in spirit $3\frac{1}{2}$ inches, slightly more than $\frac{1}{8}$ inch broad.

Prostomium not at all dovetailed into the peristomium.

Clitellum distinct and saddle-shaped, extending over segments 14-19. The whole of the anterior part of segment 14 is included, but except here the tumid portion extends as far ventrally on each side as half-way between the two inner setæ.

Setæ in four couples, the outer couple on each side twice as far apart as the inner.

Male pores on papillæ on segment 18 at the the level of the innermost setæ. Oviduct pores on segment 14 within the tumid part of the clitellum.

Spermathecal pores, two pairs, at the level of the interval between the two inner setæ of each side between segments 7 and 8, 8 and 9.

Accessory copulatory structures. A median ventral patch on segments 17 and 18. Two papillæ at the level of the innermost setæ joined together by a median ridge in segment 19.

Dorsal pores present, the first between segments 4 and 5 (?).

Nephridiopores at the level of the third setæ (!)

Alimentary canal. Gizzard in segment 5. No true calciferous glands but vascular swellings in segments 13 and 14. Large intestine commencing in segment 19, but there is no clearly marked differentiation between it and the oesophagus in front which is swollen out in each segment.

Circulatory system. Single dorsal blood-vessel. No continuous supra-intestinal. Hearts in segments 8-13.

Excretory system. Meganephric. A single large one in each segment with ciliated funnel as usual.

Reproductive system. Testes not visible, but a pair of well-marked rosettes in segments 10 and 11.

Prostates small and coiled in segment 18.

Sperm sacs, racemose, on the anterior walls of segments 10, 11 and 12.

Ovaries in segment 13 into which the oviducts open.

Spermathecæ, two pairs, in segments 8 and 9. The diverticulum simple and less than half the length of the sac.

Habitat. King Island, in Bass Straits.

## *(c)* PERICHÆTA.

(1). *Perichæta tasmanica* (Figs. 37, 38, 39). Length in spirit $2\frac{1}{2}$ - $3\frac{1}{2}$ inches, one eighth inch broad. There is a dark median dorsal line.

Prostomium dovetailed about one half or one third into the peristomium, which is marked by a median ventral cleft.

Clitellum distinct and complete, occupying segments 13-17.

Setæ. The first setigerous segment has 8 on each side. Back to the clitellum there are 10 or 11, behind the clitellum vary from 12-14.

Male pores on well-marked small papillæ placed (in spirit specimens) in a depression at or very slightly within the level of the innermost setæ of each side.

Oviduct pores on segment 14.

Spermathecal pores. Five pairs between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9, at the level of

Accessory copulatory structures. Median ventral elliptical patches on segments 9, 10, 11, 19, 20, 21 and 22.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal. Gizzard in segment 5. Three pairs of calciferous glands present in 10, 11 and 12. Large intestine commencing in segment 18.

Circulatory system. Dorsal vessel single. Hearts in segments 6-12. In segments 10-12 they arise from the supra-intestinal vessel.

Excretory system. Plectonephric: no large nephridia present. Attached to the walls of the alimentary canal in the first four segments are peptonephridial (?) glands.

Reproductive system. Testes, two pairs, in segments 10 and 11 with rosettes in the same segments.

Prostates flattened and bilobed, but with a single duct in segment 18.

Sperm sacs, racemose in segments 9 and 12.

Ovaries in segment 13 with oviducts opening into the same segment.

Spermathecæ, five pairs, in segments 5, 6, 7, 8 and 9. Each consisting of a sac with a diverticulum slightly longer than the sac and with a swollen extremity.

Habitat. Emu Bay, Tasmania, and King Island in Bass Straits.

This form is a member of the group to which belong also *P. rubra*, *P. frenchii*, *P. hoggii*, *P. sylvatica*, *P. steeli* and *P. halli*, all of which are closely allied to one another and agree in the possession of a median ventral cleft on the peristomium, in having five pairs of spermathecæ, in having three pairs of true calciferous glands in segments 10, 11 and 12, in having a plectonephric excretory system, and in having the prostate bilobed.

(2). *P. moræa* (Figs. 40, 41, 42). Length in spirits 4 inches.

Prostomium very slightly dovetailed into the peristomium.

Clitellum not marked externally.

Setæ, in front of the clitellum, vary from 11-18 on each side. Within the clitellum there are twenty-one on each side, and the same number is present behind the clitellum. The setæ form a very definite raised ridge round each segment, and the dorsal and ventral break is very small.

Male pores on papillæ at the level of the interval between the third and fourth setæ.

Oviduct pores on segment 14.

Spermathecal pores, two pairs, at the level of the interval between the first and second setæ between segments 7 and 8, 8 and 9.

Accessory copulatory structures. Median ventral ridge on segment 18 between the two papillæ; a pair of elliptical patches at the level of the interval between the first and second setæ between segments 19 and 20.

Dorsal pores present, the first between segments 3 and 4. Nephridiopores at the level of the ninth or tenth seta in the middle of the body.

Alimentary canal. Gizzard in segment 5. No true calciferous glands present. Large intestine commencing in segment 17.

Circulatory system. Single dorsal vessel. Hearts in segments 6 to 12. Supra-intestinal vessel present.

Excretory system. Meganephric.

Reproductive system. Testes in segments 10 and 11, into which also open the rosettes.

Prostates, extending through segments 17-20.

Sperm sacs, racemose in segments 9 and 12.

Ovaries in segment 13 into which open the oviducts.

Spermathecæ, two pairs in segments 8 and 9. The diverticulum simple.

Habitat. Lake St. Clair district, Tasmania.

(3). *P. richea* (Figs. 43, 44, 45). Length in spirit 3 inches, about $\frac{1}{8}$ inch broad. Dorsal surface (in spirit) purplish colour, ventral flesh coloured. A dark median dorsal line.

Prostomium about one-half dovetailed into the peristomium.

Clitellum complete, distinct, lighter than the surrounding parts, and occupying segments 14-17.

Setæ, 12 on each side in front of the clitellum, behind this the number is greater being 24 half-way along the body.

Male pores on papillæ at level of interval between the first and second setæ.

Oviduct pores on segment 14.

Spermathecal pores, five pairs, on small tumid, elliptical patches on the posterior margins of segments 4, 5, 6, 7, 8 and 9 at the level of first setæ.

Accessory copulatory structures. None developed.

Dorsal pores present, the first between segments 3 and 4.

Alimentary canal. Gizzard in segments 3 and 4. No true calciferous glands, but in segments 11 and 12 the oesophagus is white and swollen. Large intestine commencing in segment 17.

Circulatory system. Dorsal vessel single. Supra-intestinal vessel in segments 9-12. Hearts in segments 5-12, those in segments 9-12 large.

Excretory system. Meganephric.

Reproductive system. Testes, two pairs, in segments 10 and 11. Rosettes in the same segments.

Prostates, wide, tubular, in segments 17-19.

Sperm sacs, racemose, in segments 9 and 12.

Ovaries in segment 13 into which also the oviducts open, an extra pair of ovaries (or ovisacs?) in segment 14.

Spermathecæ, five pairs, in segments 5, 6, 7, 8 and 9. The diverticulum is very small at the base of the large simple sac.

Habitat. Under logs in the Beech Forest on Mount Olympus, Tasmania.

(4). *P. dilwynnia* (Figs. 46, 47, 48). Length in spirit 2 inches, $\frac{1}{8}$ inch broad.

Prostomium about one-half dovetailed into the peristomium.

Clitellum distinct, complete, occupying segments 14-17, segments 14-16 tumid, purplish colour, segment 17 not so tumid, but darker than the segments behind.

Setæ. First setigerous segment has 6 behind this back to the clitellum are 7 on each side. For 40 segments behind the clitellum, and up to half-way down the body the rows of setæ are

quite regular, behind this a few more become intercalated but the number on each side never exceed 13.

Male pores on papillæ at the level of the interval between the two innermost setæ.

Oviduct pores on segment 14, very close to, and just ventral of and anterior to, the innermost setæ.

Spermathecal pores, five pairs, at the level of the interval between the first and second setæ, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9.

Accessory copulatory structures. A mid-ventral tumid patch on the anterior margin of segment 18, two pairs of patches at the level of the innermost setæ between segments 18 and 19, 19 and 20.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal. Gizzard in segment 5. In segments 6 and 7 the oesophagus is swollen, white, but not vascular, in segments 8 to 12 it is white, swollen and very vascular, in segments 13-15 it is again white and swollen but not vascular. There are no true calciferous glands. The large intestine commences in segment 17.

Circulatory system. Dorsal vessel single. Supra-intestinal vessel in segments 11 and 12. Last heart is in segment 12.

Excretory system. Meganephric.

Reproductive system. Testes, two pairs, in segments 10 and 11. Rosettes in the same segments.

Prostates wide, tubular with racemose surfaces extending through segments 17-20.

Sperm sacs in segment 12, saccular in form.

Ovaries in segment 13 into which open the oviducts.

Spermathecæ, five pairs, in segments 5, 6, 7, 8 and 9. The diverticulum is simple and very small.

Habitat. Dee Bridge, Tasmania.

(5). *P. scolecoidea* (Figs. 49, 50, 51). Length in spirits $1\frac{1}{8}$ inch, slightly more than one quarter inch broad. The body consists of some 77 segments, the first 12 of which are a fair width, the rest very narrow indeed. The body has the general appearance of a minute annulated sausage.

Prostomium less than one half dovetailed into the peristomium.

Clitellum, not visible.

Setæ very numerous; there are at least 40 on each side, but they are very minute, and difficult to count. There is no continuous or any distinct dorsal break except at the very posterior end; the ventral break is slightly better marked, but is very small.

Male pores on minute papillæ at the level of the fourth setæ in segment 18.

Oviduct pores on segment 14 just in front of the second setæ.

Spermathecal pores, two pairs, at the level of the fourth seta between segments 7 and 8, 8 and 9.

Accessory copulatory structures, none developed.

Dorsal pores present, the first between segments 3 and 4.

Alimentary canal. The whole canal is thrown into coils. Gizzard in segment 5 and very large in comparision to the length of the body. No true calciferous glands. Large intestine commencing in segment 18.

Circulatory system. Single dorsal vessel. Supra-intestinal in segments 8-12. Lateral vessel on either side in segments 10 and 11. The last heart is in segment 12, the first round the gizzard in segment 5.

Excretory system. Meganephric. In segments 2-5 the nephridia appear to consist of a large number of coiled tubules than elsewhere. Peptonephric salivary glands present (?).

Reproductive organs. Testes, two pairs, in segments 10 and 11, rosettes in the same segments

Prostates, small, flattened, racemose in segment 18.

Sperm sacs, racemose in segment 12.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, two pairs, in segments 8 and 9. Two very small diverticula at the base of a fair sized sac.

Habitat. Under logs in the King River Valley, Tasmania.

This worm is remarkable for its short stumpy nature. It is evidently mature, though in external appearance it does not look so. Mr. Officer who found it tells me that it is very abundant, and never seems to attain to a larger size. It has not the slightest resemblance externally to a perichæte worm, and in spirit at all events the minute setæ project only a very short way from the surface.

(6). *P. irregularis* (Figs. 52, 53, 54). Length in spirit $3\frac{1}{2}$ inches, $\frac{3}{16}$ inch broad. The dorsal surface (in spirit) is purplish brown, the ventral is flesh coloured, and the setæ form a very distinct ring.

Prostomium dovetailed about one-half into the peristomium.

Clitellum distinct, complete, occupying segments 13-17 and the anterior portion of segment 18 dorsally. Tumid, and purple colour dorsally, ventrally lighter coloured. Does not hide either the setæ or the dorsal pores.

Setæ, about 13 on each side in front of the clitellum, 16 on segment 14, 15 on segment 17, 15 in the segments in the middle of the body increasing to 20 on the posterior segments.

Male pores on papillæ at the level of the interval between the second and third setæ on segment 18.

Oviduct pores on segment 14.

Spermathecal pores, three pairs. The first between segments 6 and 7 at the level of the third setæ, the second between segments 7 and 8 at the level of the fourth setæ, the third between segments 8 and 9 at the level of the fifth setæ.

Accessory copulatory structures, two pairs of elliptical patches at the level of the third setæ between segments 18 and 19, 19 and 20.

Dorsal pores present, the first between segments 4 and 5.

Nephridiopores at the level of the interval between the eighth and ninth setæ.

Alimentary canal. Gizzard in segment 6. No true calciferous glands, but in segments 14, 15 and 16 the oesophagus is swollen and vascular. Large intestine commencing in segment 17.

Circulatory system. Dorsal vessel single. The last pair of hearts in segment 12. Supra-intestinal vessel in segments 8-12.

Excretory system. Meganephric.

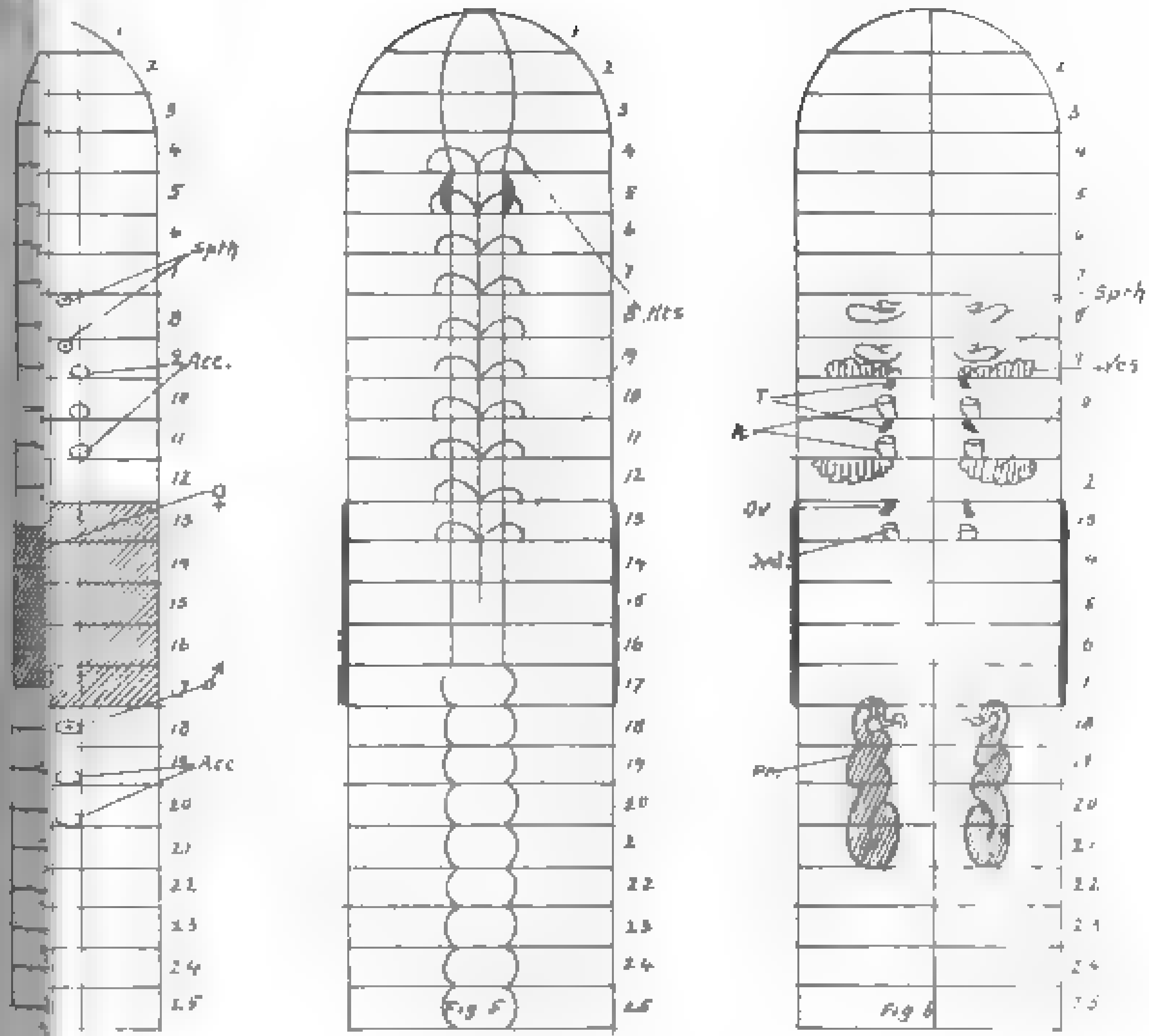
Reproductive system. Testes, two pairs, in segments 10 and 11, the rosettes opening into the same segments.

Prostates widely tubular, coiled, extending through segments 17-21.

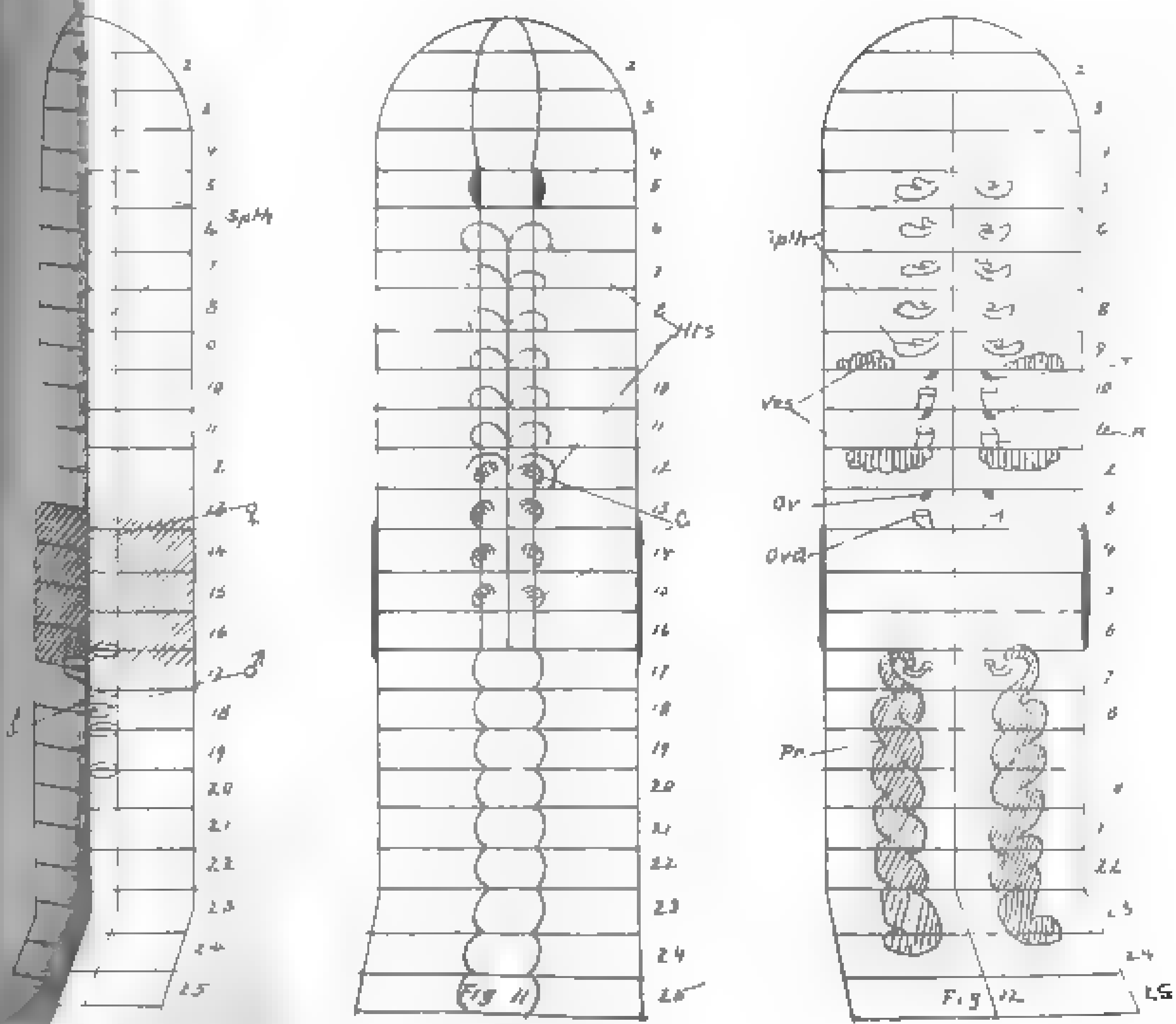
Ovaries in segment 13, the oviducts opening into the same segment.

Spermathecæ, three pairs, in segments 7, 8 and 9, e consisting of a large sac with a small simple diverticulum attac to its stalk. Special blood-vessels pass on to the surface of sac.

Habitat. King River Valley, Tasmania.




CRYPTODRILUS POLYNEPHRICUS

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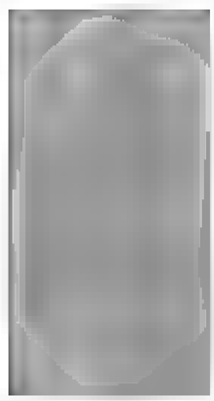
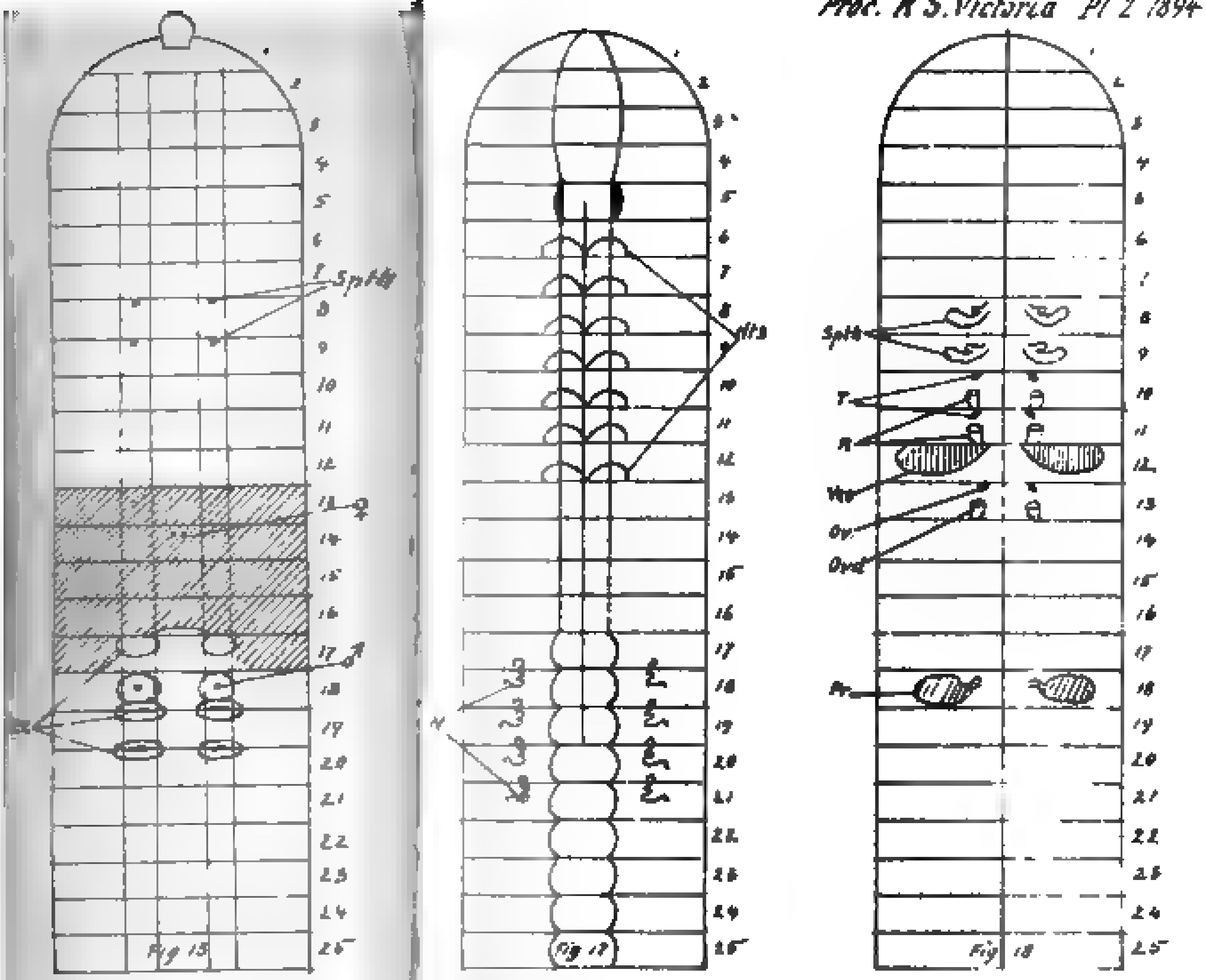
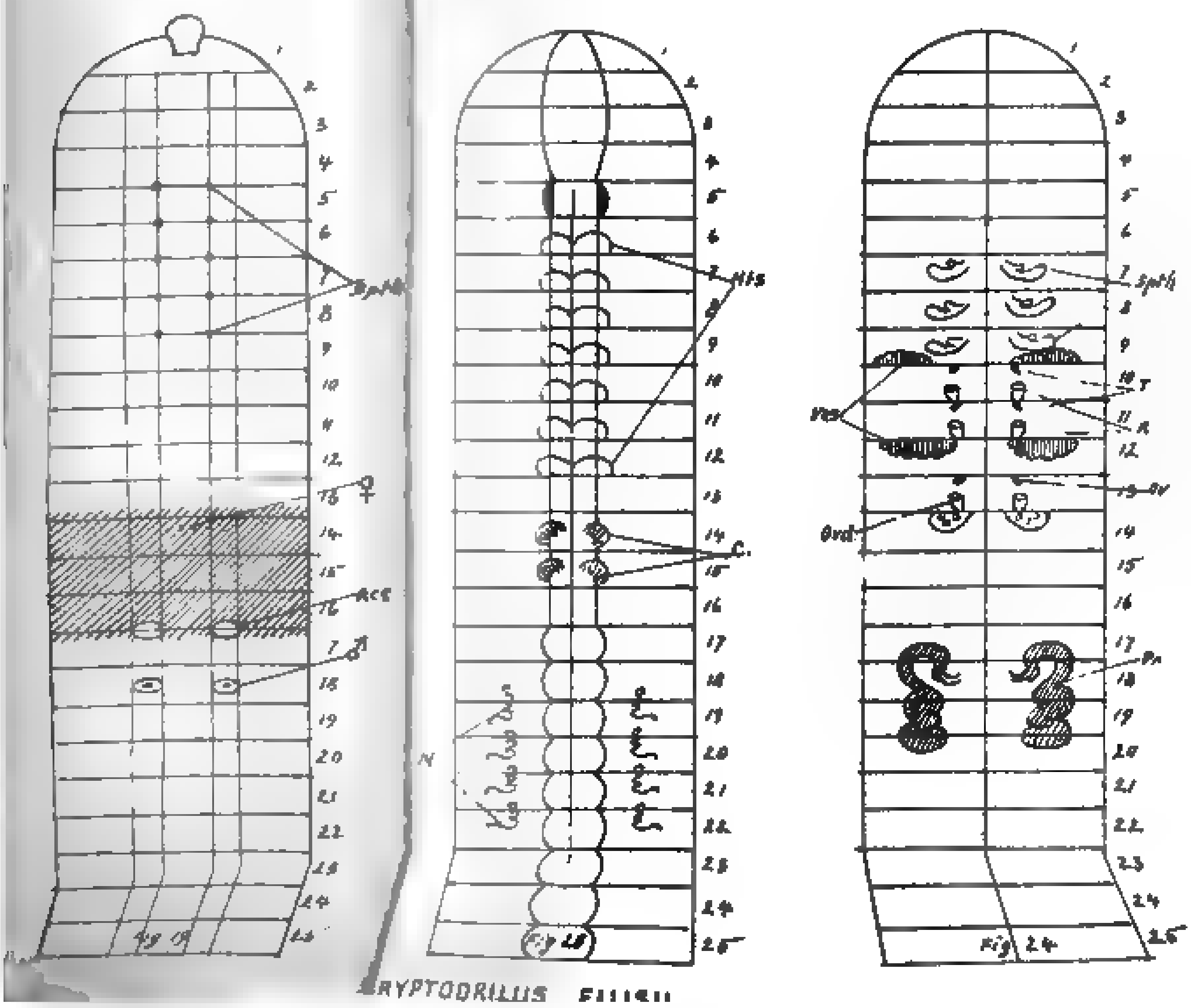




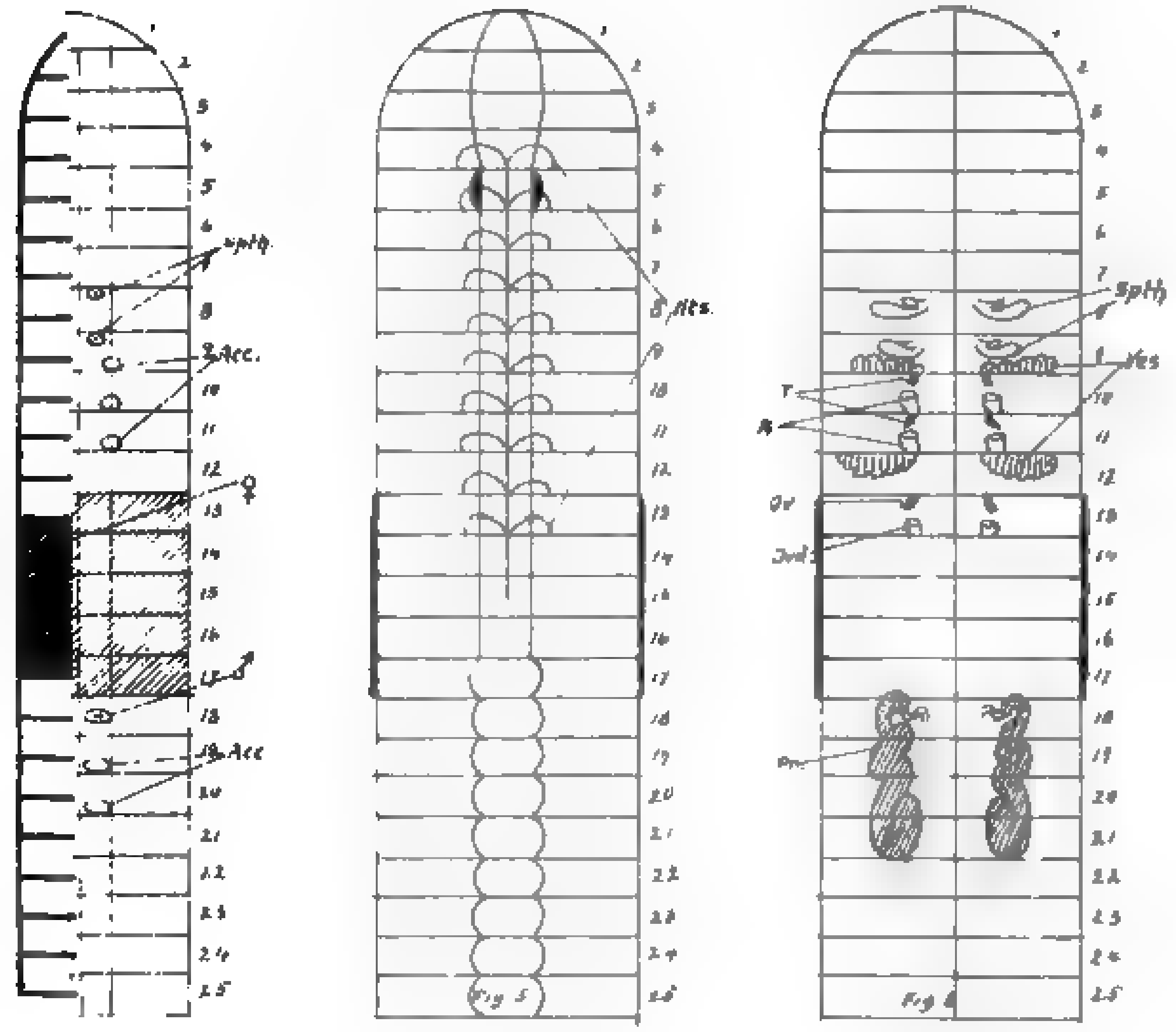

PTODRILUS TESSELATUS.



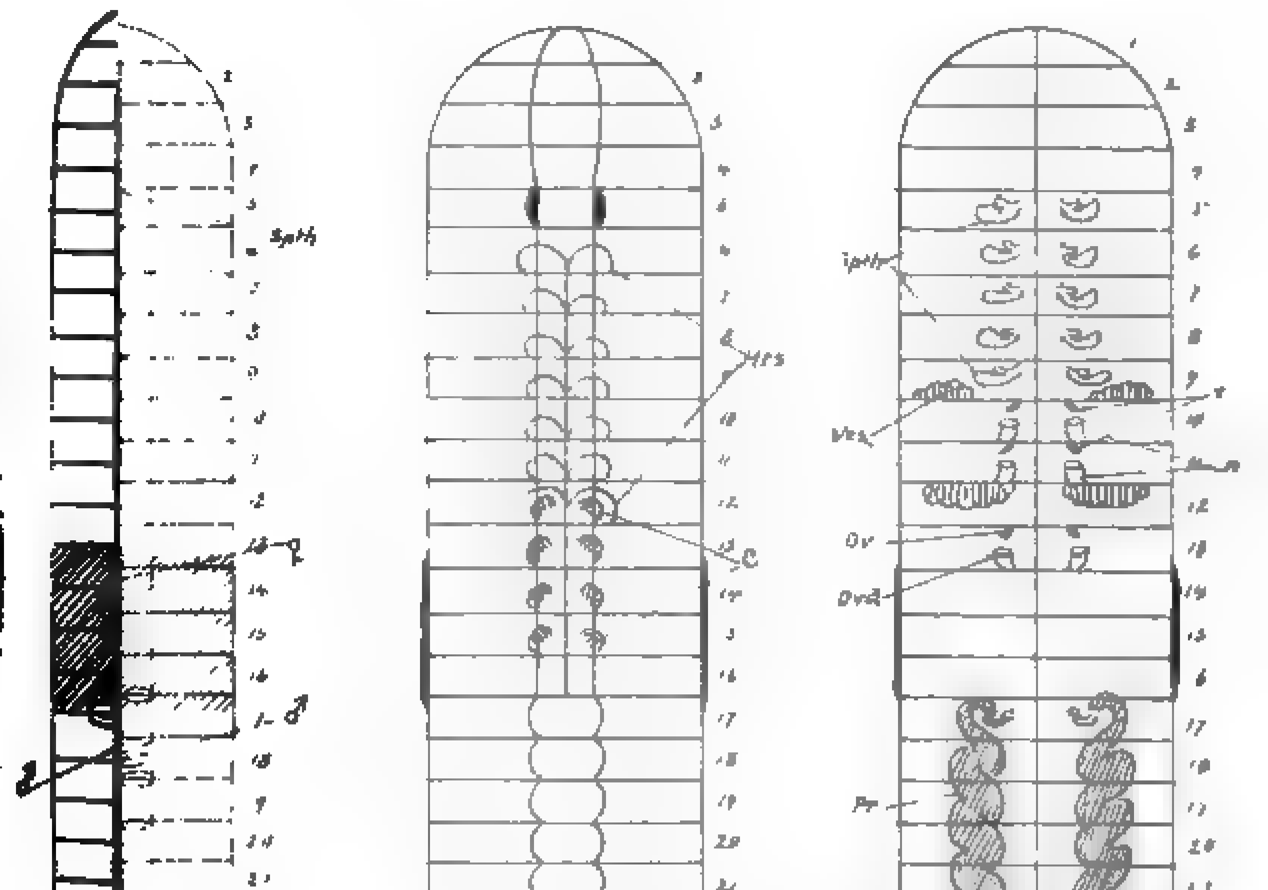

RYPTODRILUS

Spermathecæ, three pairs, in segments 7, 8 and 9, each consisting of a large sac with a small simple diverticulum attached to its stalk. Special blood-vessels pass on to the surface of the sac.

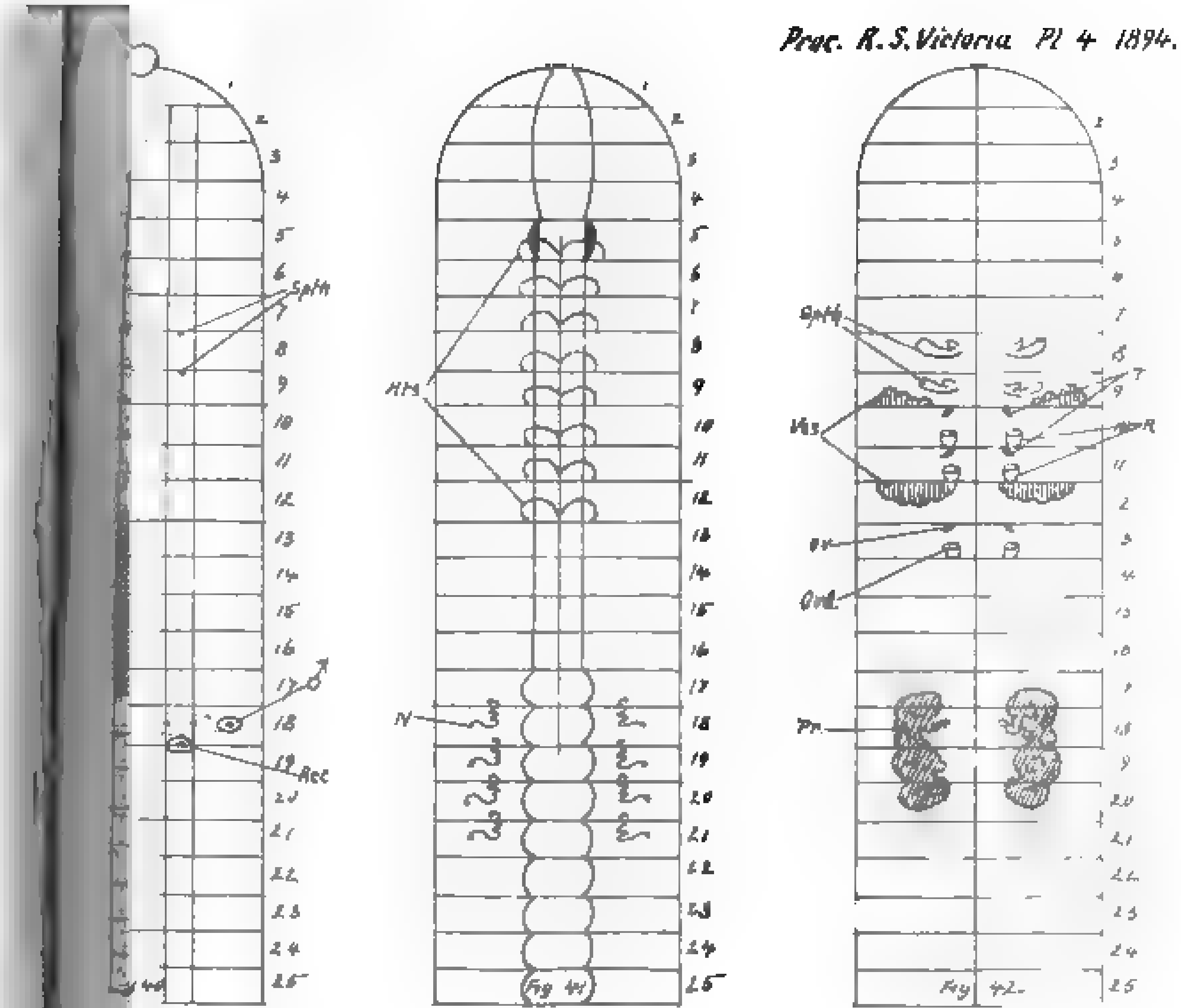
Habitat. King River Valley, Tasmania.



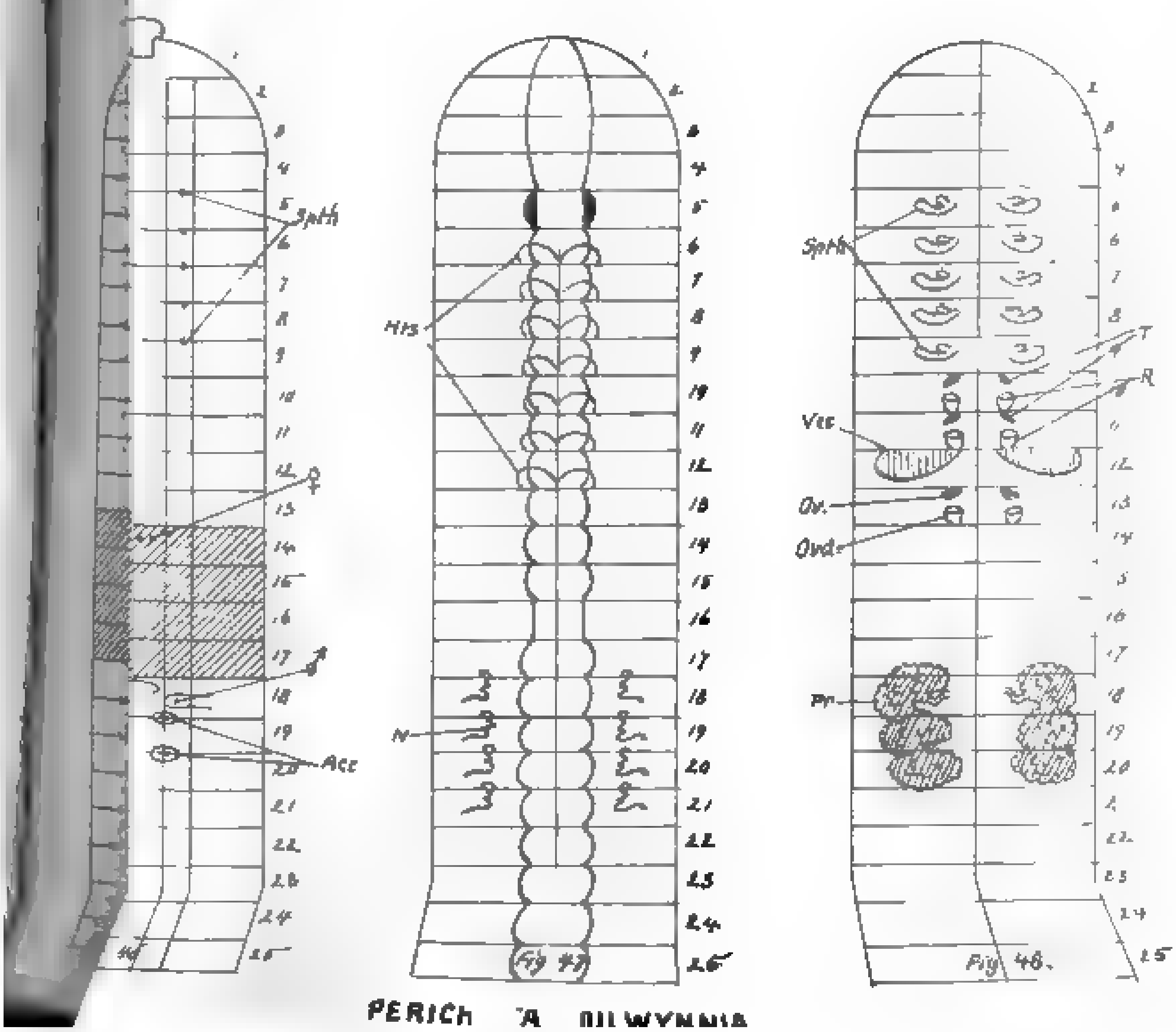

CRYPTODRILUS POLYNEPHRICUS




CRYPTODRILUS HOBARTENSIS.




PERICHÆTA MORŒA.

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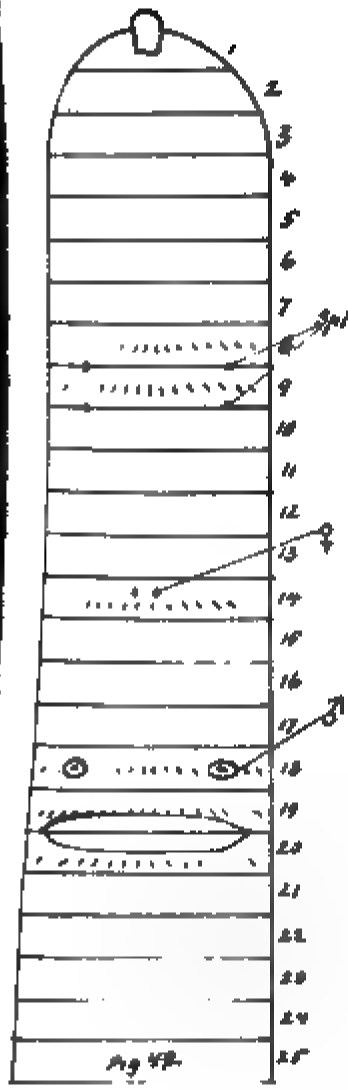


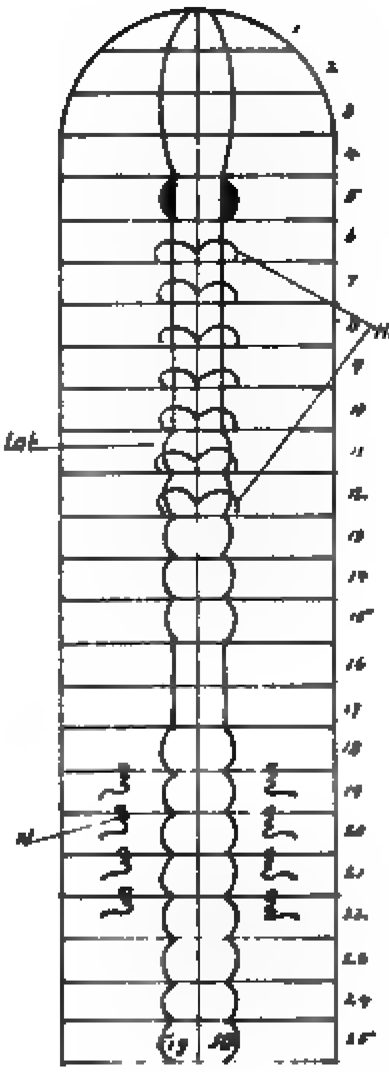


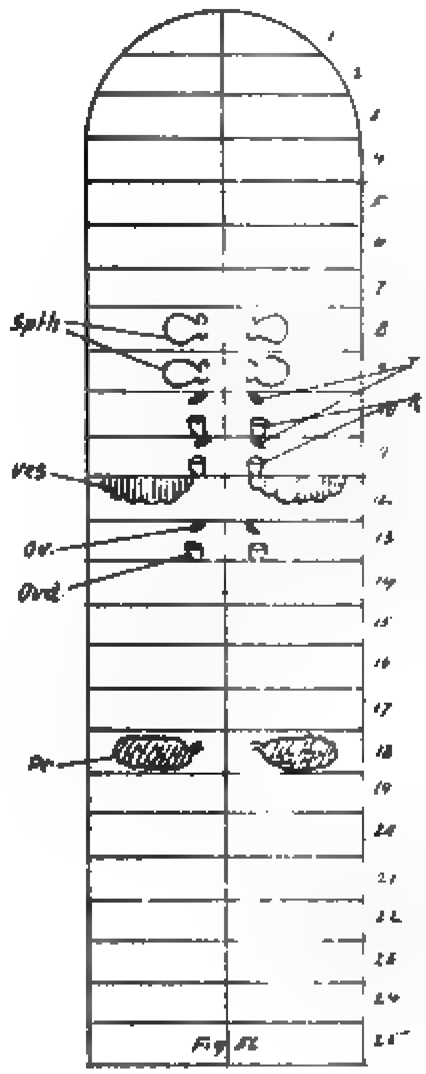


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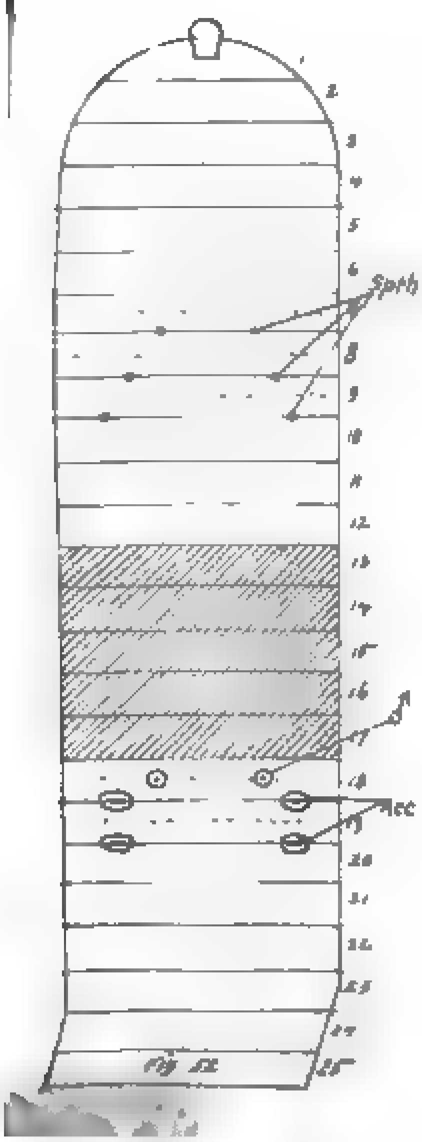
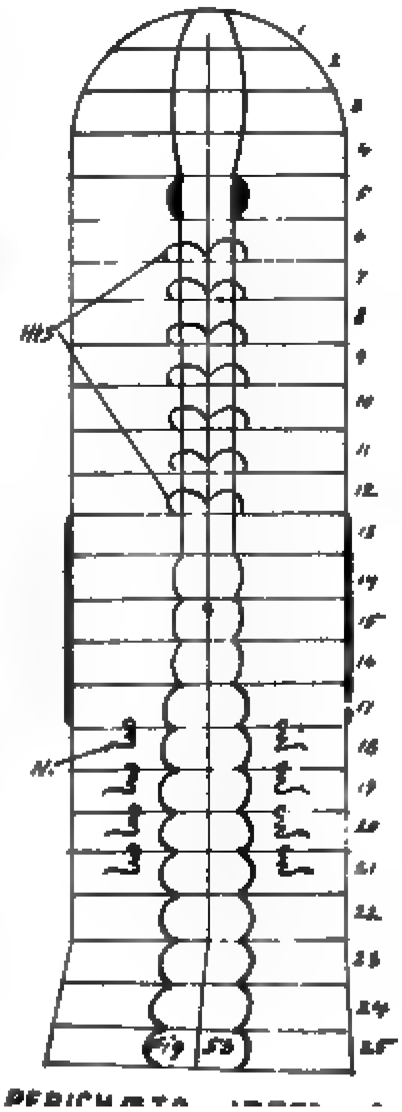
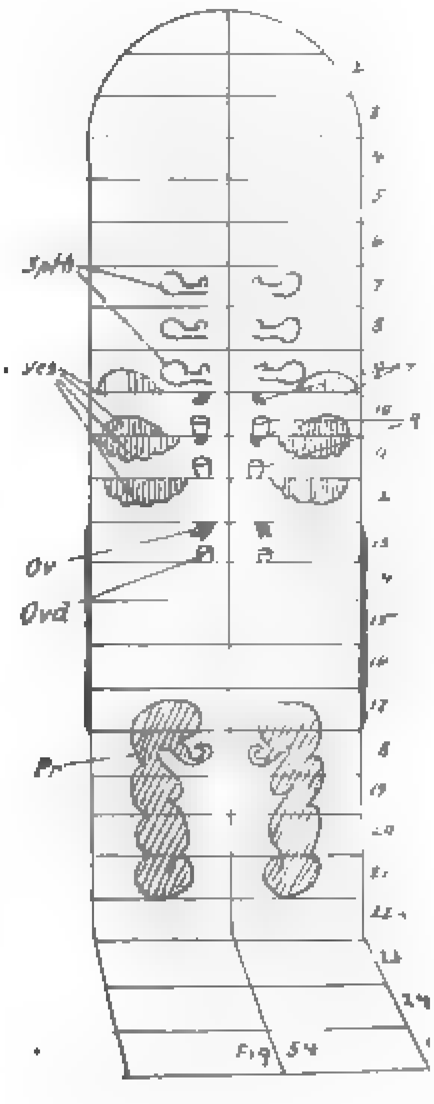



PERICHÆTA

ART. VI.—*The Geology of Castlemaine, with a sub-division of part of the the Lower Silurian Rocks of Victoria, and a List of Minerals.*

By T. S. HALL, M.A.,

Demonstrator and Assistant-Lecturer in Biology, University of Melbourne.

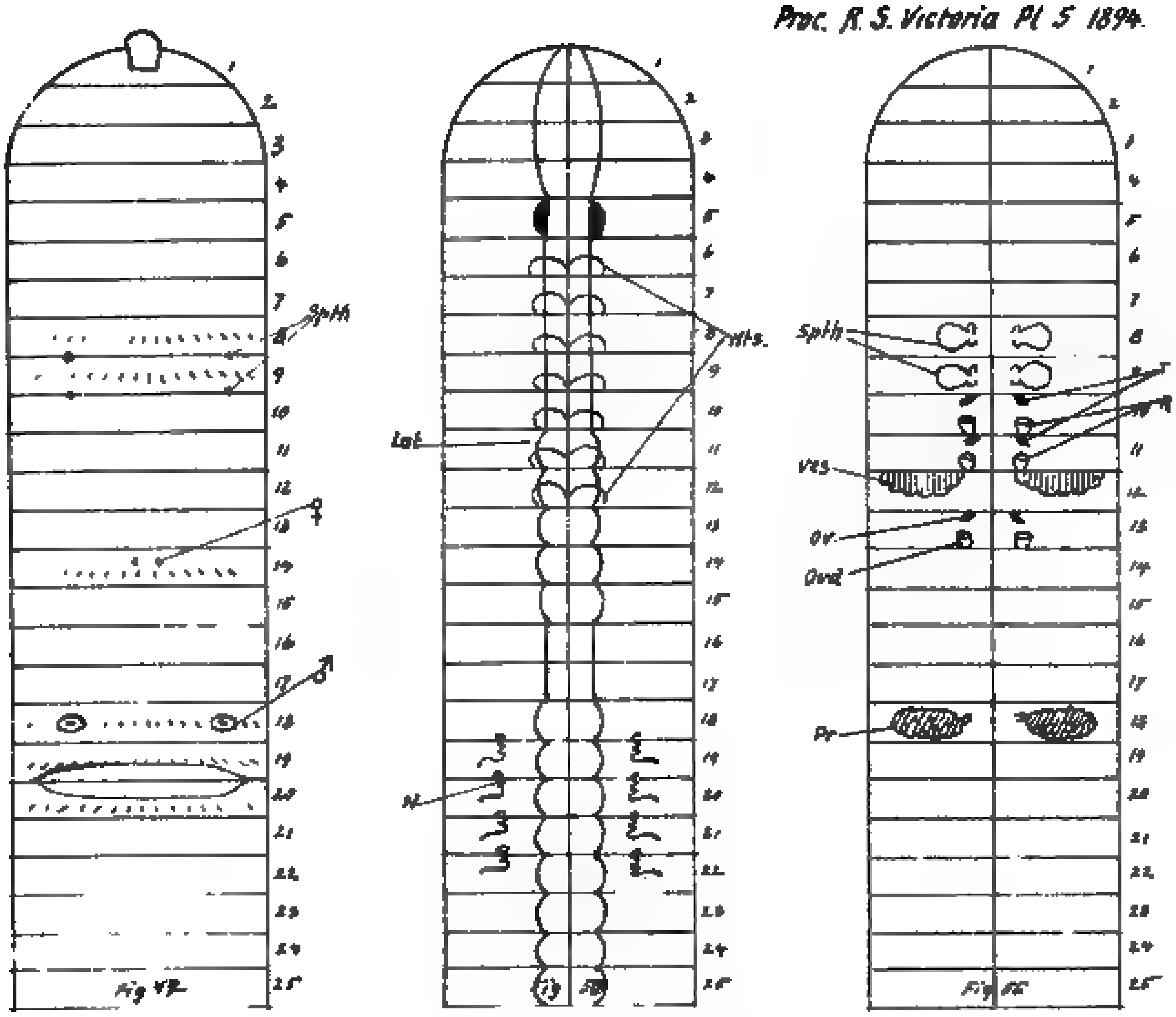
(With Plate VI.)

[Read 10th May, 1894.]

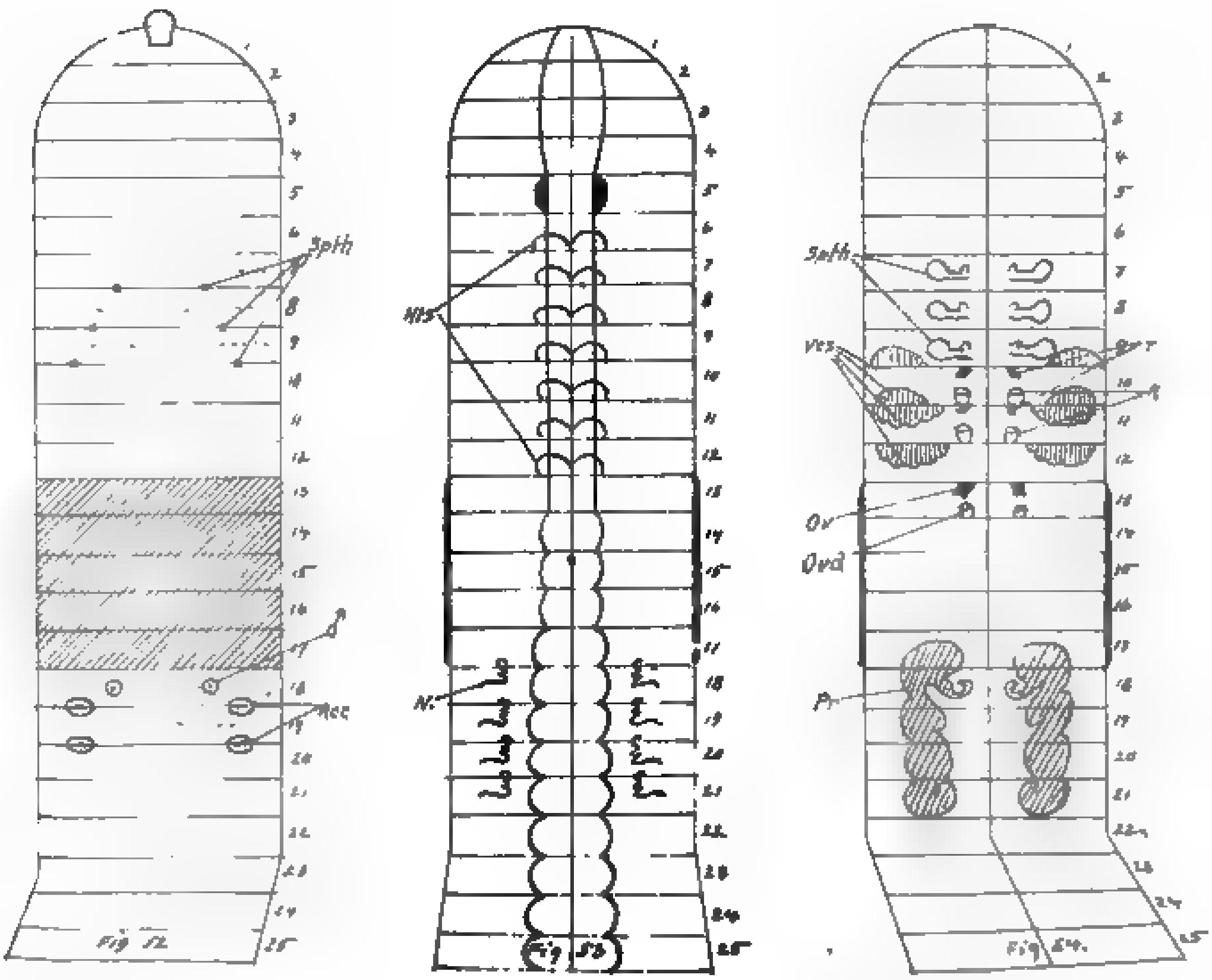
The discovery of the graptolite succession in the Castlemaine rocks has already been briefly indicated by myself in a short paper contributed to the Adelaide meeting of the Australasian Association towards the close of last year. In the present communication I propose discussing the geology of the district in more detail, and adding a few observations which have since then come under my notice.

In 1853 Sir Arthur Selwyn, then Director of the Geological Survey of Victoria, examined the district, and made a traverse of its northern part from the Campaspe to the Loddon, passing through Mounts Alexander and Tarrengower. He published a sketch map, and a section along the line mentioned, and briefly described the physical features and the rocks of the district.* Since then the most important work done has been the mapping, by Mr. Geo. Ulrich, of a large extent of country from Harcourt to Mount Franklin, and from Maldon to Elphinstone, on a scale of two inches to the mile. Selwyn, in one of his reports,† gives some interesting details of the work involved in the preparation of these quarter-sheets. He says: "In the construction of the Castlemaine sheet alone over 300 miles have been traversed solely to lay down topographical features, exclusive of the contouring requisite for hills. Three thousand holes have been

* Papers presented to Parliament 1853-4, vol. ii.—Reprinted in Q. J. G. S., vol. x., 1854.
† Geological Surveyor's Report, 1861.




PERICHÆTA SCOLECOIDEA.




PERICHÆTA

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sunk to ascertain the depth of the drift. Eighty-one holes, aggregating 827 feet, have been sunk to ascertain geological boundaries and for prospecting." With regard to the hill-shading and the topography generally, the maps are marvellously accurate. Every little rise and gully is exactly shown, and I have been constantly able, map in hand in the field, to mark my position accurately to within a few yards. Without these maps I should have been quite unable to make any progress in unravelling the stratigraphy of the district, as it would have been beyond my skill to have constructed a map, in such difficult country, which would have been of any use for detailed work.*

The town of Castlemaine lies on the chord of the arc which forms the southern boundary of the horse-shoe-shaped area of granite extending from Elphinstone through Harcourt, to a few miles south of Maldon.

### The Granite.

The area occupied by granite is, in the main, gently undulating, with a few scattered tors and bosses of rock. Occasionally it rises into lofty hills, of which Mount Alexander (2435 feet) is the highest point of the principal range. At the Harcourt granite quarries a fine face is exposed. The rock, so well known in Melbourne as a building stone, needs but little description. Normally it is a grey, fairly fine grained rock. Occasionally, red felspar occurs and gives it a pinkish tinge. Small patches of fine grained rock with more abundant black mica occur having a very definite outline. These are probably concretionary, as is stated to be the case with similar patches occurring in Cornwall.† Patches of very coarse grained rock occur at times, and on one visit to the quarry I noticed traces of a gneissose structure. Euritic dykes occur, but I have not seen any more than a few inches in thickness. Druses or Vughs are rare at the quarry, but one which occurred was lined with beautiful crystals of what Mr. O. Rule, to whom I submitted specimens, identified as Stilbite and Albin, the latter mineral a variety of Apophyllite,

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* The mile posts as marked on the quarter-sheets show a difference from Melbourne too great by about six chains. This is probably due to a deviation made at Kyneton, and the error will probably hold as far south as that township.

† A. J. Phillips, Q. J. G. S., vol. xxxi., p. 1.

not having been previously recorded from Victoria. These minerals were accompanied by crystals of orthoclase and smoky quartz. Iron and copper pyrites occur in small patches associated with minerals derived from them by alteration. I have also noted garnet and schorl from this locality. Jointing is well marked and, in the quarry, is very regular. One set of joints strikes E.5°N., another about north, both being nearly vertical; while a third set, forming the "floor" of the quarry, "dips" at an angle of about 20° to the westward. The exact agreement of the north striking joints, with the strike of the silurian rocks, is peculiar.

Near the silurian boundary, the character of the rock is more varied, and may be well studied near the Expedition Pass Reservoir, where the Sutton Grange Road passes through a cutting in the silurian almost on the boundary. Here, numerous granitic veins, of very varied character, may be seen cutting through the sedimentary rocks. Schorl is abundant, but good crystals are rare. Graphic granite is common, and fine specimens may be gathered of all degrees of texture. Leptynite also occurs, containing occasionally garnets of small size. Altogether the road-cutting in about fifty yards shows about a dozen dykes, varying from twenty feet to a few inches in thickness. The largest dyke consists of ordinary grey granite much decomposed. Another contains large plates of white mica and orthoclase crystals an inch and a half in length, the quartz being much larger. One aplite dyke, five inches in width, can be traced for about twenty yards with a strike S.40°E. The dip and strike of the silurian rocks here is normal. Another locality, where the junction may be studied, is in the road cutting under the railway bridge at Harcourt, where similar features are shown. At the point where the large water-race from the Coliban passes the junction at Elphinstone, the surface soil is too deep for observations, other than that afforded by change in colour, to be made. The spot is about one hundred yards south of the point where the Bendigo railway crosses the race, and may be seen from the train. At Maldon, north of the brewery, the actual contact may be seen in a creek section. Here the crumpled silurian rocks dip into the granite which is seen to over-lie them for several feet, having evidently been forced there while plastic.

At Bradford, a few miles north of Maldon, and well within the granitic area, many interesting minerals have been found as described by Mr. Geo. Ulrich*. Mr. J. Hornsby, of Maldon, has a splendid collection of these minerals, several of the figured crystals being in his possession.

## THE SILURIAN ROCKS.

Mr. R. Brough Smyth's description of the physical features of the palæozoic rocks of Victoria is peculiarly applicable to Castlemaine.† He says, "The course of the main streams nearly everywhere conforms to the strike of the rocks. The tributaries of the rivers are at right angles to them; and this system of drainage extends to the smallest basins. The configuration of the surface consequently is in many places curiously symmetrical. Running parallel with the main streams, we see two ranges of hills with subordinate ranges at right angles to them; and from every little range, oblong spaces of land, ending in low rocky prominences, run down towards the creeks."‡

Though the north and south valleys are in accord with the strike of the rocks, they show no constant agreement with the position of anticlinal axes, but, as we should expect in beds of such varying texture, scoop their courses out of the softest rock, and may work east or west towards its dip. Consequently the ridges are usually of sandstone, and as the gullies are steep-sided, an accumulation of loose blocks on the slopes and in the bottoms of the valleys occurs, and is apt to produce an impression that arenaceous beds form almost the whole of the series.§ The cause of the east and west valleys is probably to be found in jointing. The long west bend of Forest Creek, below Chewton, does not occupy a fault, as the anticlinal line passing through Monument Hill can be traced for a long distance to north and south, and shows no displacement near the creek.

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* Exhibition Essays, 1886; also Contributions to the Mineralogy of Victoria, 1870.

† Goldfields and Mineral Districts of Victoria, p. 42.

‡ See also Smyth Ex. Ess., 1866, p. 6.

§ Mr. Wm. Nicholas, during a series of lectures delivered in Bendigo, says, "in Castlemaine sandstones preponderate." These valuable lectures are reported in the *Bendigo Advertiser*, *Independent*, and *Evening News*, between February 11th and August 26th, 1881.

Selwyn* and Smyth† point out that surrounding the granite area of the district, the indurated silurian rocks usually form a range of steep and rugged hills. It will be noted that the Elphinstone and Big Hill railway tunnels are through these hills, while at Harcourt and near Maldon advantage has been taken of water courses to cross the boundary.

The rocks consist of slates and sandstones of all varieties of texture. The coarsest grit observed occurs near the head of Victoria Gully about the strike of the Corporation quarry and is exposed in the race. The quartz grains are about an eight of an inch in diameter and well-rounded. A similar grit occurs on the hills north of the head of Moonlight Flat, where it projects like a rampart twenty feet in height, and is traceable for a long distance. A peculiar conglomerate occurs near the seventy-third mile post on the Bendigo railway. It consists of a fairly fine-grained sandstone, in which are embedded rounded fragments of slate. One of these fragments was seven inches long and one inch thick. A similar rock occurs half a mile nearer Melbourne, and also in the creek cutting above the Francis Ormond Mine, at Chewton. Mr. E. J. Dunn‡ records a similar rock from Bendigo. A conglomerate, noted by Ulrich, occurs in the Brewery Gully, Maldon.

Some of the sandstones show a concretionary banded colouring which has a strikingly beautiful appearance. One set of beds of this description crosses the railway line at the Chewton station, being repeated several times by folding, and is traceable north as far as Donkey Gully. The same band recurs in the cutting at Scott's Hill, a mile and a half to the westward, and possibly again in New Chum Gully. Quartzites occur plentifully, usually in rather thin bands, and quartzose rocks which approach them in character, but are ferruginous, are common all over the field.

The argillaceous rocks are all more or less cleaved, and I have consequently classed them merely as slates. Mica is rarely present in the slates, though frequently so in the sandstones, some of the latter being thickly spangled with plates of a whitish variety of that mineral.

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* Parl. Papers, and Geol. Mag., *loc. cit.* † G. F. and Min. D. Vic., p. 70.

‡ Rep. Bendigo Goldfield, p. 6.

As we approach the granite traces of metamorphism become more pronounced. Flaggy sandstones and quartzites are well-developed, while the more argillaceous beds exhibit the appearance of knotted or nodular slates *(fruchtschiefer).* The bye-wash of the Expedition Pass reservoir displays a fine section. The rocks here are more than usually contorted, and vertical as well as horizontal sections can be seen showing clearly the effects of "pitch," or dip of an anticlinal axis. The nodules of these slates are rarely more than an eighth of an inch in length, and frequently smaller. They are sometimes harder, sometimes softer; than the surrounding rock, usually they differ in colour from the matrix and have the appearance of carraway seeds embedded in the stone. One specimen from here showed white crystals, probably of andalusite. I have not seen any true mica schist.

Judging from the notes on the quarter-sheet (9 N.W.) a somewhat metamorphic band runs far to the south between Taradale and Fryers. The ranges on this band are very rugged, and form a part of the spur of the Divide, which Brough Smyth alludes to as running north from the Blue Mountain through Mount Alexander.

The dense, blue quartzitic sandstone of Maldon is called "Hornfels," by Ulrich. Locally, it, like a softer rock from Castlemaine, is known as "bluestone," and is used for road metal. Owing to its brittleness it is far inferior to the softer but tougher basaltic "bluestone" which is used elsewhere.

The building stone of the district, a soft brown argillaceous sandstone, is of a very variable character and blocks of good quality are a rarity. The older buildings are in a ruinous condition from the exfoliation of the stone, brought about by the decomposition of disseminated pyrites. It is quite unsuited for ths purpose to which it is applied, though unfortunately the new bridges over the creeks are built of it.

Cone-in-cone structure is rare in the rocks, and the only good specimen I have seen was in sandstone, and not in the usually quoted carbonate of lime or of iron. The specimen was found by Mr. James Shugg near the Devonshire Mine, and subsequent search has failed to bring any more examples to light. I found a peculiar example of an allied structure near the Chinese Joss

House, below Patterson Bridge. The surface of the rock, an olive slate, was closely covered with flat oval depressions about one-fourth of an inch in diameter. In some cases, on these depressions were seated small cones about one-eighth inch in height, of a whitish colour, finely transversely striated and longitudinally more deeply gooved, and having somewhat the appearance of sessile barnacles. The flat bases were downwards, and on the cleavage planes. The apices of the cones were embedded in a softer clay, and as no trace of obverse cones was visible the name cone-in-cone will not apply. The structure is undoubtedly not organic, and Mr. Newberry, to whom I sent a specimen, submitted it to Mr. Howitt, who informs me that he considers it to be of a concretionary nature. I have seen several less perfect examples, where the cone bases if not carefully examined would perhaps be considered rain-prints, and from the cleavage making the depressions deeper on one side than on the other the direction of the wind would doubtless be inferred.

Some of the blue and grey slates are thickly marked with red oval patches, mainly on the cleavage planes. Frequently a small speck of limonite in the centre shows that a grain of pyrites has yielded the colouring matter which has spread out through the rock in the easiest direction. Small oval films of pyrites were also observed in slates at the Devonshire Mine, which on decomposition would yield the same appearance.

Limestones are apparently absent, though Mr. Dunn* records a narrow band of black limestone from similar rocks at Bendigo. The presence of lime in the beds, is shown by the occurrence of strings and patches of magnesian limestone, in joints of the slates near Patterson Bridge, and at the south end of the Barker's Creek slate quarry. The frequent occurrence of calcite and allied lime-bearing minerals in the quartz veins points to a similar conclusion.

Slaty cleavage, as before mentioned, is strongly developed all over the district, and has a strike coincident with that of the beds. Over the western part of the field, the dip of the cleavage is about 80° to the westward, but whether this direction holds for the Maldon side of the district, I cannot say. In the railway cutting, on the Elphinstone side of the tunnel, the quarter-sheet

* *Op. cit.*

has the cleavage marked at 50°. After a careful examination of this section, I feel bound to conclude that the bedding and cleavage have been confused, as the bedding is clearly seen throughout the whole length of the cutting, and that the usual high angle of cleavage is maintained. Cleavage is rarely well shown in the immediate neighbourhood of anticlines and synclines. The rocks tend to become rubbly and frequently a system of close set radial joints is developed. These joints are well displayed in many of the railway cuttings; for instance, in a syncline 200 yards west of the Elphinstone tunnel. Mr. E. J. Dunn* regards this structure as cleavage, and states moreover that the direction of the dip of cleavage varies at Bendigo, but that an easterly dip is more common than a westerly one.

There must of course, in such contorted beds as we are dealing with, be places in which cleavage and bedding coincide, but I have met only one instance of such. This is in the Barker's Creek slate quarry, where the beds dip westerly at more than 85°. Mr. Reginald Murray† says, when speaking of our silurian rocks, that "stratification and cleavage are generally identical, but cleavage distinct from stratification is not uncommon." Ulrich‡ states that the cleavage "frequently very nearly coincides with the planes of stratification." As I have searched for graptolites all over the district, the divergence of cleavage from stratification has been brought home to my mind very strongly. When the two differ much in direction, as when the beds dip east and cleavage is strongly developed, a long time has frequently to be spent in search of indentifiable fossils, till by chance a specimen is found the long axis of which accords with the strike of the rocks.

Jointing is of course usual, and well developed, in most of the sandstones. Owing to the joints being close, large blocks of stone are rarely obtainable, and frequently the sandstones are rubbly. Occasionally, as shown at the east end of Lyttleton Street, the joints are so well and evenly developed that the arch appears to be built of masonry.

*Faults.*—Strike-faults, as seen in the cuttings are very common,

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* *Loc. cit.*, p. 14. † Geol. and Phys. Geog. Vic., p. 41.

‡ Catalogue of Rock Specimens in Tech. Mus. Melb., 1875. Printed in Parliamentary Papers, and also issued separately).

and a small thrust-plane is shown on railway line just to the east of the Ten Foot Hill bridge, the amount of displacement being about four feet. Dip-faults I have not detected on the surface. By the miners they are known as "cross-heads," and frequently cut off the reefs or quartz veins. Diagonal faults, or "counters," "caunters" or "quonters," as the miners call them, also occur, and in some cases, as in the "No Name Reef" to the south-west of the Crown Nimrod Mine, are occupied by auriferous quartz veins. Slicken-sided rock is plentiful, and I have found well-polished faces of quartz from fault walls. The quartz veins usually occupy faults which generally have opened along the bedding planes. In the creek, to the east of Mr. James Newman's house, a block of sandstone contains small seams of slate and in these slates are many small seams of quartz, which have formed between the cleavage planes, and do not pass into the uncleaved sandstone. Selwyn* states that the large quartz reefs often occupy a similar position. "Saddle-reefs," such as occur at Bendigo, appear rare, and but few reliable instances are recorded. These reefs (formed as Mr. Wm. Nicholas, Mr. E. J. Dunn, and others have minutely described, in cavities produced on the anticlines by the unequal bending power of the various rocks) which are the source of the greater part of the Bendigo gold, are frequently reported in this district from the most impossible places. One mine in particular, during my residence in Castlemaine, reported having struck a "west-leg" of such a "formation" and were cross-cutting east to strike the other leg, which they professed to expect at a very short distance, while, as a matter of fact, the anticline on which alone such a reef could be formed lay at a distance of over 300 feet away. Fortunately, of course, gold occurs plentifully in reefs which are not "saddle-reefs," and "saddle-reefs" are just as likely to be non-auriferous as any others. A small "saddle-reef" was struck in the Ajax mine on the anticline about sixty feet east of the shaft, and another occurs on the Daphne reef anticline in Lost Gully. Many of the mines of the district are near anticlines, but quite as many, if not more, are far from them. As an example of the former, we may note the Devonshire mine, and the eastern shaft

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* Ex. Ess., 1866, p. 13.

of the South Wattle Gully Co.; while the once fabulously rich mines on the other side of Wattle Gully, are as near to a syncline as to an anticline. The Bolivia reef occupies a fault with a western hade, the country rock dipping east. The country in the neighbourhood of quartz reefs is usually so disturbed that observations of dip are unreliable in these localities.

*Rock folding.*—The whole series of rocks is much folded and crumpled. Hand specimens may be gathered which show the folding on the most minute scale and such crumpled rock generally occurs near the axis of one of the larger anti- or synclines. To this puckering, I feel constrained to put down most, if not all the instances quoted, of "ripple marks" in our silurian rocks. Two such instances may be noted. Mr. E. J. Dunn* speaking of the Bendigo "saddle-reefs," describes the rock slipping that must have taken place during their formation,† and then notices that one wall of the original cavity shows ripple-marks beautifully developed, that is, just at the place where rock-slipping must have been greatest. The other instance occurs in the bed of the Moonee Ponds Creek, near the Park Street bridge. In this case also, there has been considerable rock movement, for the bed which shows the marks is about eighteen inches below a thrust-plane, which is accompanied by shattered rock, and small veins of quartz. Innumerable other instances may be quoted, but when we are dealing with rocks like those of Castlemaine, which have an average dip of over 70°, or of Bendigo with one of 65°, the simplest explanation seems to be that the structure is a form of crumpling, for were it otherwise, its observance would be a rarity instead of one of the commonest of occurrences.

The larger anticlines succeeded each other very rapidly, the average distance being 300 yards. In the water-race from Chewton to Castlemaine, along the hill slopes to the south, I have plotted thirteen in two and a half miles. This agrees closely with what occurs at Bendigo.‡ The anticlines can be traced for long distances. For instance, I have traced the anticline through Monument Hill for two and a half miles. The anticlines have a fairly constant strike of N.5°W. Owing to the way in which

* *Loc. cit.*, pp. 6 and 12.

† See also Wm. Nicholas, F.G.S., in *Bendigo Advertiser*, and *Bendigo Independent*, August 27, 1881, for similar explanation.

‡ Dunn, *loc. cit.*, plan.

they die away and are replaced by others, the folds may be compared more with sea-waves than with anything else. The Ajax anticline may be taken as an illustration. A well-marked anticline may, as before mentioned, be seen about twenty yards east of the shaft, the strata dipping east and west for some distance from the axis. This axis may be traced, with but a small intermission, caused by a gully crossing it, as far north as the Maldon railway line. Here, as shown in the cutting, it has almost disappeared, and is merely represented by a slight roll in the strata, the main dip being westerly. Still further north, in the cutting in front of the Church of England Parsonage, its only trace is a crumpling of the slates. The anticline to the eastward is now the main one. Near the Ajax it is scarcely, if at all, noticeable. Its axis is shown at the south end of Barker Street, and it passes through the Corporation quarries in Bull Street, near the railway line, and it is now an important fold.

Besides this dying away of anticlines, it is of course the rule in disturbed rocks that the axes of the folds are rarely horizontal. Owing to the peculiar structure of the Bendigo "saddle-reefs," and the great extent of the underground workings, Mr. Dunn and the mining surveyors have been enabled to work out the "pitch" or dip of the axis very thoroughly. Similar facilities do not occur in Castlemaine, but in a few instances the top of an arch is sufficiently bared to enable observations to be taken. The most striking example I know occurs near the head of Sailor's Gully,* the gully next to the north of German Gully. (The exact spot is a few yards west of a quartz reef, as shown on the map, crossing the valley). At first sight it appears like a dip-fault, as two parallel bands of sandstone occur with a strong outcrop. In reality, however, they belong to distinct beds, and their disappearance north is caused by a "pitch" of about 40° and the bands curve round as they "nose-in" on the flat. This is the highest "pitch" I have noted, but Mr. Dunn records one of 60.°† As attention has only recently been called to the effects of pitch on the structure of our goldfield areas by Mr. Dunn, perhaps a few localities had better be recorded where it can be studied in this district. The anticline at the east end of Lyttleton Street pitches 13° to the southward; another on the east side of Wattle Gully,

* ¼ S., 13 S.W. † *Loc. cit.*, p. 12.

about 100 paces south of the S. W. G. Co.'s eastern shaft, pitches 12° N.; another, south of the Campbell's Creek Road, just above where Dead Horse Gully joins the creek, pitches 12° N. and is a fine example. Mr. H. W. Green, legal manager of the Ajax Co., read me the mining manager's reports for 1890, from which it appeared that the anticline previously noticed in that mine carried at the 900 feet level a small saddle-reef. This was "driven on" north, for some distance, and, after undulating slightly, finally took a strong northerly pitch and passed underfoot. Out of a total number of eight instances, in which I have recorded pitch in my notes, seven showed a northerly inclination, and the palæontological evidence seems to point to a general northerly pitch of all the rocks to the east of Castlemaine. Professor J. D. Dana* points out that in order to get a thorough knowledge of the pitch of strata in any disturbed district, thousands of dips must be accurately plotted, a labour from which, for many reasons, I have shrunk.

*Dip.*—Over the eastern portion of the district, from Barker's Creek to the granite, there are numerous good exposures and dip can easily be observed. From Elphinstone to Chewton the railway cuttings give an almost continuous section; while from Chewton a water-race extends along the hill-sides as far as the Ajax mine. To the westward of Barker's Creek the country is more deeply masked by surface soil, the gullies are fewer and of less importance, and the scrubby timber is thicker, so that I was unable, after several futile attempts, to make any satisfactory number of observations. The Maldon railway line has such shallow cuttings that, for that part of the field, I have had in great measure, to fall back on the recorded observations of others. In railway cuttings, where nearly vertical beds are cut obliquely to their strike, the slope of the cutting gives an apparent dip in different directions on opposite sides, and on hill-slopes especial care must be taken, as surface slipping renders all observations except on a north or south slope of little value.

From Elphinstone, nearly to Chewton, the dip, owing to constant inversion is westerly, and the bending over of the beds can be well traced in many places. In the deep cutting at the west end of the tunnel a fine anticline is displayed in grey

* *Nature*, vol. xlvi., p. 154.; also Amer. Jour. Sci., June, 1892.

sandstone, and is best seen from the top of the cutting on the south side. East of the anticline the beds dip more and more steeply to the east, and at about thirty paces have completely turned over, and dip west. The syncline near the drain, about 150 yards west, behaves similarly, so that a constant westerly dip holds throughout the cutting. The next cutting to the west is still more interesting. It is 350 yards long, and about thirty feet deep for most of its length. An anticline occurs 180 yards from the west end, and, as the rocks are shattered in its vicinity, some care is requisite for its detection. For a few yards east of the anticline the beds have a high easterly dip, then become vertical, and finally turn over with a westerly dip of about 75°, which is maintained to the end of the cutting. The variations in the texture of the beds are great, but, speaking generally, the rocks grow finer as we ascend, and pass from grits to fine grey slates. All the beds are repeated, so that a band of graptolitic slate recurs at each end of the cutting. Fossils were extracted with difficulty, and are badly preserved. Among the forms were *Didymograptus bifidus*, *Tetragraptus bryonoides*, *T. caduceus*, *Goniograptus sp.*, *Phyllograptus* several forms, *Dendrograptus sp.* and *Lingulocaris M'Coyi*, the horizon being thus clearly shown. The inversion can be clearly traced in several other cuttings, and in the creek sections towards Chewton, but none are so well-marked as this.

The quarter-sheets do not show that the great amount of inversion here displayed was detected. The only indication of any overturned beds that I can find is given on ¼ S., 9 S.W., near the south-west corner, where a brief note records its occurrence. This locality is nearly on the strike of Chewton and Fryers. I may say that it was on palæontological grounds that I suspected the inversion, as the succession of the graptolites was not in accord, apparently, with that near Castlemaine. From Wattle Gully to Castlemaine the beds are less disturbed, and the anticlines are more easily detected. A series of about seventy observations gave an average dip of a little over 70°, there being no marked difference between the amounts of easterly and of westerly inclination, though the general dip is westerly. How far this general westerly dip extends I cannot say. From my own, admittedly imperfect, observations, I had put the main syncline

down as about a mile and a half west of the town. Selwyn and Ulrich both state the general dip about Maldon to be easterly, and the former has placed the syncline further west near Muckleford Creek.

In a mining district, where everyone is a geologist, it is unfortunate that the geological term "dip" should be, as here, misused, and still more, used in a different sense in Castlemaine from what it is in Bendigo. The strike of our silurian rocks, both upper and lower, is constantly nearly north and south, so that in a mine we generally have two sets of workings. One set ("drives") agrees with the strike, and the other ("crosscuts") with the dip joints. Any bed or vein with an east or west inclination is said to "underlie" or "underlay," while any north or south inclination of a vein or dyke is called the "dip" at a given rate. The distinction has, of course, a practical value, or it would not be used. In the Bendigo "saddle-reefs" the miner's "dip" is the geological "pitch." In Castlemaine, a vein with a north-east dip would be said to "underlie" east and "dip" north, the true dip being resolved into two directions at right angles.

## The Graptolite Succession.

Mr. G. H. F. Ulrich, in his valuable catalogue above quoted, states that "owing to the absence of distinctive beds, such as conglomerates and limestones, together with the fact, that the same genera and species of graptolites occur throughout the lower silurian series, no means at present (1874) exist for subdividing the formation." On first examining the graptolites in the immediate neighbourhood of Castlemaine, I was at once struck by the difference of the facies from the one I was already familiar with at Bendigo, and a closer examination of the district showed that there was a gradual change in the character of the fauna on going eastward. This discovery was, of course, only made after many long walks and fruitless searches for fossils amongst the rugged hills that surround the town. The spoil heaps of the gold workings, which lie in every direction, are for the most part old and weather-worn. Pyrites, and other easily decomposable minerals, have aided in the work of destruction, and it is consequently an exception to find graptolites in

these localities, sufficiently well preserved for recognition. Even when, after long practice, I was able to judge that a certain outcrop would yield fossils, a couple of hours work with the pick, often not only showed the correctness of the judgment, but also that cleavage and weathering had almost entirely destroyed the characters of the specimens. Ultimately, however, a few localities were found, from which a fair number of species were procured. The change of fauna from east to west has already been alluded to, but the work of correlating the scattered outcrops at first presented great difficulties, as they were dotted irregularly over six or seven square miles of rugged country, and I was uncertain which were the upper and which the lower beds. Fortunately my first systematic attempt was completely successful, and, as I suspected from the general westerly dip, the beds south of Chewton were the lowest. I chose an outcrop at Daphne Reef in Lost Gully, as my starting point. Here, almost on the summit of an anticline, a small excavation yields forms identical with those of the central part of Bendigo. The commonest and most characteristic form is *Tetragraptus fruticosus.* This occurs of all sizes, and some of my specimens quite dwarf all illustrations I have seen. The branches, after the outward curve, run in a straight line, and the form has the appearance of *Didymograptus V-fractus* (Salter), but its true tetragraptid nature is clearly shown in several specimens. In one example from this locality, one branch is over eight inches in length, and is broken at the distal end. I have similar specimens from Bendigo, but none so large. The anticline was traced over very rough ground, north, for three-quarters of a mile, and *T. fruticosus* was found all the way, till I found myself in Wattle Gully, to the west of another good locality. Owing to the steep slope of the ground the last part of the work had been very difficult, and I spent over an hour breaking slate, before I found the required specimen of *T. fruticosus.* This zone, the *T. fruticosus* zone, is 200 feet below the next above. The intervening rocks are clearly shown in the race, to the south, but yielded no fossils after several visits.

The second zone, just mentioned, which I worked principally from a small shaft in the South Wattle Gully Claim, is characterised by the extreme relative abundance of *Didymograptus bifidus,* which apparently ranges no higher, though it occurs

rarely in the zone below, and I have specimens from Bendigo and Tarilta on the same slab as *T. fruticosus*. I have found five outcrops of this, the Wattle Gully zone, namely, two previously mentioned near the Elphinstone tunnel, one to the south of the head of Poverty Gully, one near the head of Kampf's Gully, and this one in Wattle Gully. The Kampf's Gully outcrop is near a syncline which was traced south to near the Eureka reef, when the same relation to the *T. fruticosus* zone was again observed. A specimen of *Dichograptus octobrachiatus*, with a central disc, was secured from the lower zone at this locality. The only other specimen of this variety I found at Burns' Reef in a higher zone, and it has not hitherto been recorded for Victoria.

I have not been able to accurately trace the relationship of the Wattle Gully zone, to the next above, as a considerable thickness of sandstone intervenes, and is exposed both to the east and the west of the Chewton anticline. To the east of the head of Victoria Gully, at Nicholson's Reef, in Dog-leg Gully, and at Burns' Reef fossils occur, which I believe belong to the same horizon. There are no well-marked forms especially abundant, but the beds may be distinguished from those below by the absence of *D. bifidus*, and from the zone above by the still comparative rarity of *Tetragraptus caduceus*. In default of a distinguishing species, I have called this the *Burns' Reef* zone, from the locality where I found the best exposures. At this place a thickness of three hundred feet of unfossiliferous concretionary-banded sandstone, and slate, separates it from the zone above.

This upper zone is characterised by the relative abundance of *Phyllograptus* associated with *Tetragraptus caduceus* (Salter). The former genus is abundant throughout all the beds, from this horizon downwards, but though plentiful in this zone is not found above it. *T. caduceus* ranges throughout all the Castlemaine rocks, being rare in the lowest beds, but gradually increasing in numbers and in size at the same time, as we go upwards. In the *T. fruticosus* zone it is rare and small. It is but slightly more abundant in the Wattle Gully beds, and it is not till the present horizon is reached that it becomes a dominant form. I have called this the *Phyllograpto-caduceus* zone, a useful though perhaps awkward term.

From the outcrop mentioned, west of Burns' Reef, I have traced this zone in a northerly direction as far as Donkey Gully, where it is found passing to the west of the Crown Nimrod shaft, a distance of a mile and a quarter. Another outcrop occurs in Deaf Ben's Gully, a mile to the south of Burns' Reef, but not on the same strike, as the beds repeat to the east. Another outcrop occurs in the railway cutting, twenty paces west of Ten Foot Hill Bridge, and is traceable in a southerly direction for about a mile. At the head of Victoria Gully it is found to overlie an outcrop of the Burns' Reef beds, being separated from them by a thickness of about 230 feet of sandstones and coarse grits. An outcrop is also seen on the east side of New Chum Gully, close to the Ajax anticline.

The next zone is a well-marked one. *Tetragraptus caduceus* occurs in the greatest profusion; I think fully eighty per cent. of the specimens belong to this form. Several good exposures occur, and a great part of my earliest collecting was done on the various outcrops of this zone. *Phyllograptus*, as before mentioned, has disappeared, while immediately below it is fairly abundant. One or two species of *Diplograptus* occur somewhat commonly, though rare below this horizon, together with several species of *Didymograptus* and one of *Dichograptus*, which I have not yet identified with certainty. In Victoria Gully, where a spoil-heap from a small mining shaft on the east side of the gully yielded a good collection of forms, I was able to measure the thickness separating this zone from the one below, and found it about 250 feet. This estimate was checked in the railway cutting about half a mile north, and the results were in accord, as I measured the distance west of the *Phyllograpto-caduceus* zone, and found the *T. caduceus* zone at the required spot.

The next zone contains *Loganograptus Logani* associated with numerous examples of *T. caduceus*. An outcrop occurs at the head of John o' Groat's Gully, being separated by a thickness of 300 feet from the *T. caduceus* zone below, both occurring on the same side of the same (Ajax) anticline. It is on the strike of the eastern limb of this anticline that Professor Sir F. McCoy records *Loganograptus* from Barker Street, Castlemaine. As far as I can learn the spot was in front of the Mechanics' Institute, and is now inaccessible; but in a yard behind one of the shops I

was able to obtain evidence of the existence of the *T. caduceus* zone with a dip to the east. From this evidence I looked for and found *L. Logani* a mile to the south as above indicated. *L. Logani* is abundant in this zone, and I have a doubtful fragment from the zone below.

This species has been confounded with two others from which it, however, is quite distinct. In its method of branching it is truly dichotomous, excepting as an abnormality, when a branch is occasionally suppressed, and the branches arise at no great distance from the centre. The genus with which it has been confused is *Goniograptus* (McCoy), in which true dichotomy does not occur, but as described by Professor McCoy,* each of the four main branches is angularly bent, and from the salient angles secondary branches are given off, which alone are celluliferous. A branch stripped of its hydrothecæ would have the appearance of *Thamnograptus*. *Goniograptus Thureaui* (McCoy), the type of the genus, has about forty-eight branches, is rather rare, and is confined to the *T. fruticosus* zone. Another species has from twelve to sixteen branches, and is common in the same zone but occurs, though rarely, as high as the Burns' Reef beds. An examination of a large number of specimens of the latter species leaves no doubt in my mind that it is congeneric with *G. Thureaui*, but specifically distinct. Herrman† describes and figures a species as *Dichograptus Kjerulfi* which has a similar aspect to the present form. I have not seen the central disc he describes, and the constant differences in the number, form and arrangement of the hydrothecæ show that our form is distinct from Herrman's. The method of branching is so striking in McCoy's genus that, in spite of Herrman's objection, I think it should stand, and, moreover, that Herrman's species should rank under it. The horizon he quotes for Sweden, is *Lower Phyllograptus shales*, just where it occurs with us, and there, as here, it is not associated with *L. Logani*. Mr. R. Etheridge, Junr.,‡ figures two examples which he calls *L. Logani*, but both are evidently referable to *Goniograptus*, the characters of which had not then been pointed

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* Prod. Pal. Vic., Dec. V., pl. 50, also A.M.N.H., vol. xviii. (1876), p. 129.

† Geol. Mag. 1866, pp. 13, *et seq.*, transl. and abrd. by W. S. Dallas from Nyt. Mag. for Naturvid, vol. xxix.

‡ A.M.N.H., vol. xiv., 1874, pl. iii., figs. 11 and 12.

out by Professor McCoy. Fig. 11 is apparently *G. Thureaui* and fig. 12 is this new species. Etheridge, moreover, amongst other associated forms, quotes *Phyllograptus typus*, a genus which in Victoria does not range as high as the *Loganograptus* zone and *Didymo. Pantoni* (McCoy, M.S.). This latter species Professor McCoy* says is identical with Hall's *Tetragraptus fruticosus*, an identification which is frequently overlooked. Sir Frederick McCoy also records *L. Logani* from Newham,† but an examination of the specimens in the National Museum, on which this record was presumably founded, shows that they have the aspect of *G. Kjerulfi*, and the non-occurrence of *Loganograptus Logani* at Bb. 29 is also shown by the fact that *Phyllograptus typus* is also quoted by the Professor from the same locality (Bb. 29). In fact it appears that Bb. 29 is on an outcrop of the *Tetragraptus fruticosus* zone. Herrman‡ also seems to have considered the two forms as identical at one time, but to have subsequently altered his opinion. Having regard to the different horizons of the two forms, the importance of distinguishing them will be manifest.

Above the *Loganograptus* zone, my detailed observations do not extend. To the westward of Castlemaine, fossils are very scarce, a single specimen of *Phyllograptus* was gathered by Dr. Dendy, in my company, on the strike of about 200 yards west of where I have noted the occurrence of the *Loganograptus* zone, and a few specimens of *T. caduceus* from the same and other localities are almost the only identifiable fossils I have seen. The difficulties attending their discovery here, have been noted above. In his notes on the Maldon sheet, Ulrich states that the only fossil found in the silurian rocks of that district was a single specimen which he quotes as *Hymenocaris vermicauda* (Salter). Possibly this is the ubiquitous *Lingulocaris McCoyi* (Eth., Jun., = *Hymenocaris Salteri*, McCoy, M.S.). Mr. Norman Taylor also mentions§ that he has found no graptolites in the country immediately south of the Maldon strike. From Daylesford, however, twenty miles south on the same auriferous band, we find graptolites in profusion, and a small collection in the possession of Mr. John Hammerton, of Geelong, the only ones from there

* Prod. Pal. Vic.

† Bb. 29, in Prod. Pal. Vic., Dec. 1, p. 19.

‡ *Loc. cit.*

§ Rep. Min. Surv. Vic., Dec., 1888, p. 70.

which I have seen, contained the characteristic species of the *Tetragraptus fruticosus* zone. I cannot help feeling that the same zone will be found at Maldon, though the highly metamorphic character of the rocks will make the discovery of fossils difficult. My last excursion before leaving Castlemaine was made with a view of carefully searching the railway cuttings on the Maldon side of Muckleford Creek. The first likely-looking spot after leaving Maldon, however, was found only nine and three-quarter miles from Castlemaine. Graptolites were found on the first trial, but unfortunately were so decomposed that I could not identify them. Numerous small crustaceans, possibly *Lingulocaris*, also occurred. This was the only place where fossils were obtained, though the country near Fentiman's Reef would, I think, repay further search.

### THE GRAPTOLITES OF OTHER LOCALITIES.

The careful way in which the localities of specimens were recorded on the maps, by the officers of the old survey, and the references to those localities by Professor Sir Fredk. McCoy, in his "Prodromus of the Palæontology of Victoria," enable us to make some interesting comparisons, and, at the same time, cause us to wish that we had further elucidations of the hieroglyphics on the maps. The fauna of the lowest Castlemaine zone, which I have observed, agrees with the beds of Bendigo in a very marked manner. The Bendigo beds which I have examined most closely are in Derwent Gully, a little below where the Carshalton anticline crosses it, and at Ironbark, just west of the Victoria Quartz Mine, as well as less thoroughly at many other spots. Mr. Wm. Nicholas, F.G.S., has given me a small number of slabs of slate from near the Old Sarnia Reef at the south of the field, and all three localities agree very closely in their fauna. The agreement of an outcrop at Daylesford with this zone has already been indicated. Besides Bendigo, Professor McCoy records *T. fruticosus* from Spring Plains (Bb. 45, Bb. 46, ¼S. 13 N.E.), the Upper Loddon on the strike of Chewton and Fryers (Ba. 76, ¼S. 9 S.W.), and a couple of miles east of Gisborne (Ba. 71, ¼S. 6 S.W.) These localities then contain beds at or near the same horizon, though doubtless it will be possible for subdivisions to be made later.

With regard to the Lancefield beds, the plentiful occurrence of highly compound forms would lead us, by analogy with the succession in localities in the northern hemisphere, to place them below the lowest of all the beds dealt with. Fortunately we have evidence of a stronger character which points in the same way. A striking slender bifid graptolite occurs commonly at Lancefield, and I have found specimens at Daphne Reef, and Derwent Gully. *Clonograptus* occurs, at any rate as high as the Burns' Reef beds in Castlemaine, but is rare, while several species occur at Lancefield. The Bendigo Museum contains a fragment labelled "Bendigo," which is apparently the gigantic species described by Mr. G. B. Pritchard as *Temnograptus magnificus* from Lancefield, where it is common. In a paper read at a recent meeting of this Society, Mr. Pritchard records *Tetragraptus quadribachiatus* from the same locality. It occurs in the *T. fruticosus* zone, is very abundant in the Wattle Gully beds, and occurs, though rarely, as high as the *T. caduceus* zone. The genus *Phyllograptus* is not represented in the Lancefield beds, but is recorded by Professor McCoy not far to the westward, and on examining the specimens from this locality, in the National Museum, I detected one or two small specimens of *T. fruticosus* on one of the slabs. The evidence then points to the fact that the Lancefield beds are below the *T. fruticosus* zone, and probably at no great distance.

The graptolitic slates of Darriwill (19 S.W.) are apparently on the horizon of the *L. Logani* zone for that species and *T. caduceus* are, according to Professor McCoy, very plentiful at that locality,* and the specimens quoted are on view in the National Museum. Graptolites are recorded from many other lower silurian localities in Victoria, but till further observations are made, and more of the species are identified, it will be rash to assume any succession based solely on that of the northern hemisphere. Probably the same general succession will hold, but it is quite likely that certain species and genera will be found to have a different range in the two regions, so that inferences based on the few recorded species for these other localities may quite possibly be erroneous.

* Prod. Pal. Vic.

In New Zealand it may, however, be noted that graptolites occur, and Sir James Hector* gives some woodcuts of species found there. These are, however, not named in the work, and the figures alone merely give general characters. All the figures might be intended for forms which occur in the Wattle Gully or in the *T. fruticosus* zone in Castlemaine, and the former is the more probable horizon.

The results obtained may be tabulated as follows, the beds being arranged in descending order :—

1. Zone of *Loganograptus Logani*, occurring at Castlemaine and Darriwill.
2. Zone of *Tetragraptus caduceus*, occurring at Castlemaine.
3. *Phyllograpto-caduceus* zone, occurring at Castlemaine.
4. Burns' Reef beds, occurring at Castlemaine.
5. Wattle Gully beds, occurring at Castlemaine and (?) New Zealand.
6. Zone of *Tetragraptus fruticosus*, occurring at Chewton, Bendigo, Spring Plains, Tarilta, Upper Loddon, Daylesford, Gisborne, and to north-west of Lancefield.
7. The Lancefield shales.

With regard to the extension of the zones in the line of strike, the important effects produced by "pitch" must be recognised, as has been so fully indicated by Mr. E. J. Dunn in his "Report on the Bendigo Goldfield." There is evidently a strong northerly pitch in the great Chewton anticline, as, although I have carefully examined the area north of Forest Creek, I have never been able to find traces of any but the second and third zones. The sixth zone again occurs at Tarilta, approximately on the strike of the highest indicated zones at Castlemaine.

*Auriferous Bands.*—The fact that the auriferous quartz-veins of Victoria occur in fairly definite bands of country, separated by non-auriferous bands of lithologically similar strata, is one that early impressed itself on observers, and it is difficult to say who first noted the fact. Sir Alfred Selwyn records it, and Mr. Evan Hopkins† also mentions it. In a recent report of the Mining Department an old letter to the Governor of the Colony from

* Cat. Geol. Exhibit, Ind. and Col. Ex., 1886, p. 82.

† *Q.J.G.S.*, vol. x., p. 324.

Mr. J. A. Panton, then warden of the Bendigo goldfield, shows that he was one of the earliest to point out the same fact. Mr. Wm. Nicholas, F.G.S.,* has worked these bands out in great detail; and Mr. Reginald Murray† follows out the same principles. Both of these gentlemen have, since then, repeatedly called attention to these facts as an aid to future mining operations. In the Castlemaine district the main auriferous band strikes through Fryers and Chewton, and is approximately on the same strike as the richest portion of the Bendigo field. In the former district the band is seamed with reefs that have yielded almost fabulous quantities of gold, and most of the auriferous gullies head to this line. The chief apparent exceptions to this last fact are those gullies which receive the drainage of gullies cutting through the older gravels. As we go westward from this line, and travel over higher beds, the rich reefs grow fewer and fewer, and we have no well-marked lines like the one mentioned. When we reach, what Selwyn states to be the highest beds of the district, on the meridian of Muckleford Creek, the quartz-reefs are apparently more numerous than ever, but the richly auriferous country-rock is not there to feed them, and they are barren. The quarter-sheets show that nearly every gully in this locality was carefully searched for gold by the survey party, but without result, and this for miles to the north and south. Since then the Mining Department has, by a carefully chosen series of bores, tested the deep ground of Muckleford Creek, but with a like negative result.‡ In the Lancefield rocks again, no gold occurs. It appears then, that the auriferous strata of our lower silurian rocks begin above the base of the apparently thick *T. fruticosus* zone, and range, at anyrate, as high as *Phyllograptus* does, but probably no higher. That the recurrence of the auriferous bands across the colony is due to the recurrence of the same sets of beds, is so very probable, that the idea is the common property of geologists, but no attempt has, I believe, been previously made to show how these beds might be distinguished.

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* Prog. Rep. Geol. Surv. Vic., vol. iv., p. 145.

† Geol. and Phys. Geol. Vic., p. 157.

‡ Ann. Rep. Sec. Mines, 1890.

*Thickness of the Strata.*—Sir Alfred Selwyn* gives a section, before noted, passing through Mounts Alexander and Tarrengower, and on the evidence of this, states that the thickness of the silurian rocks of *this district* is not less than 35,000 feet. To get this thickness on this line of section, and with the average dip he gives, no allowance can be made for repetition by folding. I cannot find that he ever gave reasons for altering his opinion on this point, but we find him in 1861 (Ex. Ess., p. 177), and again in 1866 (Ex. Ess., p. 11), applying these figures to the whole of the upper and lower silurian rocks combined. This, his more recent statement, has been generally followed and quoted. Now the west end of the silurian trough of his section is nearly on the strike of the Chewton anticline, where it runs into the granite; so that perhaps he could have calculated the true thickness of the Castlemaine series along his section line, though, from the indications of a northerly pitch, I do not think so. Since the days when Selwyn made this traverse of a difficult and practically unexplored country, and without suitable maps, great changes have taken place. Railway and road cuttings, water-races and mines have given facilities, that he was without, for examining the rocks.

The lowest beds, as shown by the presence of *T. fruticosus*, crop out near the west end of the Elphinstone tunnel, so that we have here an anticline, which, though auriferous west of Taradale, at Drummond and Lauriston, some miles to the south, is very poor in quartz-reefs, and apparently non-auriferous at this locality. A slight syncline occurs to the west, at about the meridian of the seventy-fourth mile post on the railway line, though the highest zones are missing. The crest of the next great anticline runs, as before stated, through Chewton. Selwyn places the main syncline between Castlemaine and Maldon, about Muckleford Creek. Taking this last observation of his as correct, we can calculate the thickness approximately. From the Eureka Reef, where an outcrop of the *T. fruticosus* zone occurs, to the west end of John o'Groat's Gully I have plotted all the anticlines and synclines I could detect. In this distance (two and one-eighth miles) I find:—

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* Parl. Rep., *loc. cit.*, and Q.J.G.S., vol. x.

| | | | |
|---|---|---|---|
| The total amount of westerly dip shown is | | 2376 | yards. |
| „ „ | easterly | „ | 1364 „ |
| „ | excess of westerly | „ | 1012 „ |

The mean of sixty-seven observations of dip is a trifle over 70°. If we assume this excess to be constant as far as Selwyn's syncline, and assuming the dip to be, as I believe it is, at the same rate, we get in five and a half miles an excess of 7858 feet of westerly dip exposed, which is equal to a thickness of 7500 feet. If we add 500 feet for the probable thickness exposed below the Wattle Gully beds, we may put down the total thickness of the lower silurian rocks exposed in *this district* as 8000 feet. As yet we have no means of even guessing the total thickness of our lower silurian rocks, and of the thickness of our upper silurian we know nothing.

## Newer Rocks.

The only other sedimentary rocks of the district are the old and recent river gravels. Castlemaine itself is a little over 900 feet above the level of the sea, and none of the older gravels are more than 1100 feet. The latter usually occur here as cappings to minor hills, which they have protected from denudation. The linear arrangement of these hills, and frequently their relation to the present drainage system, shows them to be of fluviatile origin, and Selwyn† did not intend the general remarks he made in reference to some marine tertiary gravels to apply to this distinct, or to Bendigo, though it is often stated that he did so. Even when the relation of the old gravels to any drainage system sufficiently large for their accumulation is not apparent at first sight, the effects of denudation must be borne in mind. On this head Colonel (then Captain) Couchman, formerly Chief Mining Surveyor, makes some able and interesting remarks.* Taking most of his illustrations from this district, he shows how changes in the courses of rivers may be made, by tributary streams cutting back, and by main streams working towards the dip, till another water-shed is tapped, and the old river-bed

* Ex. Ess., 1866, p. 22. † Smyth's Goldf. and Min. Dist. of Vic., pp. 158-60.

with its gravels is left in what is, at first sight, an inexplicable position. Since he wrote, the subject has received considerable attention in the United States.*

The officers of the Survey have devoted a great amount of care to these economically valuable beds,† and have divided the gravels of this district into older and newer pliocene and recent. The evidence of the separation of the first two named, is frequently very obscure. I do not see, for instance, how the lower portion of the Forty-foot Hill deposit is classed as of the same age as that capping Diamond Hill, lower down the same stream and about eighty feet higher above sea level. The character of the deposits is described in the greatest detail by Ulrich, and it will suffice to state that all the rocks in the gravels accur *in situ* in the present water-shed, there being a preponderance of those found near the granite boundary. The indurating action of metamorphism is shown both by the range bounding the granite and by the occurrence of fragments many miles below the metamorphic zone. Slickensided fragments frequently occur, but I have not seen any examples of which could be referred to glacial action. Some terrestrial fossils are recorded on the Southern Maldon sheet from these older gravels. Amongst other specimens was an almost complete skull of *Sarcophilus ursinus*. The only organic remains I have found are a few traces of plants which were, however, quite indeterminate.

## Volcanic Rocks.

Dykes of basic volcanic rock are fairly common, though very few are shown on the map, their small size and decomposed condition rendering their detection at the surface almost, if not quite, impossible. The rock contains numerous crystals of olivene and hornblende, frequently of large size. Black mica occurs in a dyke at the Eureka Reef and in one near Harcourt, at the latter place sometimes reaching three-quarter inch in diameter.‡ One dyke, six feet thick, at Burns' Reef, is traceable north for more than a mile; others occur on the west side of Wattle Gully, at the Englishman's Reef, Ajax Mine, while several are exposed in

* Contributions to "Science," 1893, &c.

† Ulrich—Cat. Rocks, &c., p. 189, *et seq.*, and reprinted in Lock's Practical Gold Mining.

‡ See also Ulrich, *loc. cit.*, p. 35.

the railway cuttings near Chewton, and I could quote many more in the district. Lithologically, judging by hand specimens, the rock seems to resemble that of the Bendigo dykes which Mr. Howitt calls Limburgite.* At Maldon, in the Eaglehawk Mine, a beautiful green dyke-stone occurs containing massive garnet, hornblende crystals, pyrrhotite and other minerals. Mr. Pritchard tells me that Mr. A. W. Howitt, who examined a specimen for him, says the rock consists entirely of Diallage.

Mount Consultation, four miles south-west of Castlemaine, is an old volcanic neck. Very little scoriaceous material remains, and on the south side the dense basaltic rock rises almost precipitously from the silurian below. The basalt is almost black, very fine grained, rarely vesicular, and has in some places a platy structure. The divisional planes are marked by whitish bands, and have a "dip" of about 40° inwards towards the vent, as shown on an arc of about 90°. The aneroid reading gave the height as 300 feet above the Castlemaine station or about 1200 feet above sea level. What is apparently a still more denuded neck, occurs at the head of the southern arm of Diamond Gully. The surface of the rock has been denuded equally with the silurian and occupies an area of about twelve acres, the ground being cultivated. The rock is apparently similar to that of Mount Consultation, but contains numerous angular fragments of sandstone embedded in it. A quarry hole twenty-two feet deep occurs, and the owner says the rock grows denser with increase of depth. Lower down the hill a shaft was sunk to pierce the basalt; at twenty-two feet however work was suspended. The gully which heads to this outcrop received its name from the occurrence of zircons, pleonastes and other gems derived probably from the basalt itself. Gems are also recorded from the older drifts of Diamond Hill. In order to ascertain the relative age of the basalt, I tried to find whether any had been procured from the oldest drift on the hill-top, but without success.

At Guildford, at the junction of Campbell's Creek and the Loddon, we find the older drifts capped by a basalt flow which, originating near the head waters of the ancient stream, has followed its course as far as the junction of Muckleford Creek.

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* Notes on Samples of Rock, &c. Special Rep. Min. Dep., 189?, p. 1.

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* Notes on Samples of Rock, &c. Special Rep. Min. Dep., 189?, p. 1.

*Cassiterrite*, rare in Belltopper lead, Taradale (U.)

*Cerussite.*—Nicholson's Reef (U.)

*Chabazite* in basalt, Malmsbury (U.) Beehive Reef, Maldon (J. Hornsby).

*Chalcopyrite* in grains quartz reefs, Castlemaine and Maldon, as a vein several inches thick, Eaglehawk Reef, Maldon (U.) Harcourt granite, in small patches (H.)

*Chalybite.*—Eaglehawk Reef, Maldon, as lodestone of vein of copper-pyrites. Lisle's Reef (U.) See *Dolomite.*

*Chlorite.*—Rare as scaly coatings, Lady Gully and Wattle Flat, Blacksmith's Gully in quartz. In slate, Yandoit (U.) Coating imperfect quartz crystals and by decomposition, giving them a roughened appearance. Quartz Reef, Upper Loddon. Identified by Professor A. Liversidge (H.)

*Chromic iron* impregnated in quartz and quartzose rocks, Strathloddon (U.)

*Chrome ochre.*—Found at Strathloddon by Mr. (Colonel) Couchman (U.)

*Copiapite (?)*—As brownish crusts and stains on spoil and pyrites heaps (H.)

*Copper* (native).—Sparingly with gold, Specimen Gully Reef (U.)

*Copperas.*—In crystals, Beehive Reef (U.)

*Covelline.*—Specimen Gully (U.) Coating chalcopyrite, Harcourt and Scotchman's Gully (H.)

*Damourite.*—Bradford lead enclosed in smoky quartz (U.)

*Dolomite.*—Crystals, Lisle's Reef (U.) Varieties of calcite containing various quantities of iron and magnesia occur in various rhombohedra in Ajax and Wattle Gully Reefs, &c. Lenticular masses, strings and veins occur in the slates at Specimen Gully, Forest Creek. A white, soft, earthy substance consisting of carbonates of lime and magnesia occurs at the Barker's Creek quarries. A magnesian-lime cement occurs in some of the old gravels (H.)

*Epidote* (Epidote-rock).—Dyke, two and a half miles S.E. of Tarilta (U.)

*Epsomite.*—Eaglehawk Reef (U.) Argus Hill Co., as thick incrustation in old drives (H.)

*Galena.*—In nearly all auriferous reefs (U.) In fairly large grains, Scotchman's Gully (H).

*Garnet* (common red).—Drift of Barker's Creek, crystals embedded in smoky quartz, Bradford Lead (U.) In diallage dyke, Eaglehawk Reef (J. Hornsby); in granite, Maldon (J. Dennant); in granite, Harcourt quarries; granitic dyke, Expedition Pass (H.)

*Gold.*

*Graphite.*—An impure graphite coats slates in vicinity of quartz reefs, *e.g.*, Ajax, Englishman's, and many other reefs (H.)

*Gypsum.*—Clays, Mount Consultation, Sandy Creek (U.)

*Gumbelite* (?)—Replacing graptolites (H.)

*Heulandite.*—Sparingly, as drusy coatings, Lisle's, Lennox, and Tiverton Reefs (U.)

*Hyalite.*—Common in dolerite, Malmsbury (U.)

*Ironglance.*—In tabular crystals in quartz reefs, Sandy Creek; in tabular crystals in dolerite, Malmsbury (U.)

*Labradorite.*—Dolerite, Malmsbury, Loddon outliers.

*Limonite.*—As nodular concretions and veins in silurian rocks at Fryers, Maldon, Castlemaine, as cement of older drifts (U.) Pseudomorph after cubical pyrites; Wattle Gully, Bolivia Reef, forming iridescent films on rocks, common (H.)

*Magnesite* concretions in various localities (U.); concretions in Kampf's Gully (H.), Maldon (J. Hornsby).

*Magnetite* and *Ilmenite*, as black sand in alluvial deposits draining from basaltic country (H.)

*Malachite.*—Nicholson's Reef (U.); small earthy patches Scotchman's Gully Reef (H.)

*Maldonite.*—Nuggety Reef (U.) An alloy of bismuth and gold is obtained in some mines in Maldon at times, on "retorting" the mercury.

*Mispichel.*—Various recorded localities, massive, and in crystals (U.)

*Molybdenite.*—Granite, Maldon (U.) Quartz reefs, Maldon (J. Hornsby).

*Mountain leather.*—Tarilta (U.) Associated with tabular crystals of calcite in quartz reef, 900 feet level, South German Mine (H.)

*Muscovite.*—Granite generally (U.)

*Nontronite.*—Maldon (U.)

*Oligoclase.*—Scoria, Mount Franklin; greenish, in granite, Tarrengower, Harcourt (U.)

*Olivene.*—Newer basalt generally. Mount Franklin ash (U.) Basaltic dykes.

*Orthoclase.*—Granite generally; granite boundary, Elphinstone, Maldon, Harcourt. Large crystals, Bradford (U.) Large crystals, Mount Barker and Expedition Pass (H.)

*Pharmacosiderite.*—In cubical crystals, Beehive and German Reefs (U.)

*Pholerite.*—Blacksmith's Gully (U.); Ajax and Garfield Reefs, &c. (H.)

*Pyrite.*—Common in cited localities (U.) Cubes, Wattle Gully, in sandstone, &c. Octahedra, South Wattle Gully Mine. Pentagonal dodecahedra, Devonshire Mine (H.)

*Pyromorphite.*—Nicholson's Reef (U.)

*Pyrrholite.*—Specimen Gully, and several Maldon Reefs (U.) In diallage dyke, Eaglehawk Reef, Maldon (H.)

*Quartz.*—Common as reefs, hooded quartz, Pigeon Hill (figured) crystals large, Blacksmith's Gully, &c. (U.) *Smoky quartz:* Bradford, Tarrengower (U.) Harcourt Quarries (H.) *Prase:* Lady Gully (U.), Blacksmith's Gully, Ajax Reef, &c. (H.) *Lydianite:* Veins, Joyce's Creek (U.)

*Sapphire.*—Common in drift, Vaughan (U.)

*Scorodite.*—Crystals, Beehive Reef (U.)

*Selenite.*—Mount Consultation (U.)

*Sphalerite* (Zincblende).—Nuggetty Reef (U.) With gold, Francis Ormond, and Crown Nimrod Reefs, Scotchman's Gully, Mopoke Gully (H).

*Steatite*, as a vein, Strathloddon (U.)

*Stibnite* (Antimony glance), Fentiman's and Eaglehawk Reef (U).

*Stilbite*, in druse, in granite, Harcourt (H.) Identified by Mr. O. Rule.

*Sulphur* (native) with grey antimony, Fentiman's Reef (U.)

*Topaz.*—Gold drifts of Castlemaine district, Bradford lead (U.)

*Tourmaline.* Granite, of Mount Alexander, at Maldon (U.); Expedition Pass (H.)

*Wad* (black ferromanganese ore), quartz reefs common, as cement of conglomerates, Strangways, Tarilta (U.)

*Wolfram.*—Sandy Creek (U.)

*Zircon.*—Gold drift, Tarilta, Guildford, Hardhills, Campbell's Creek (U.)

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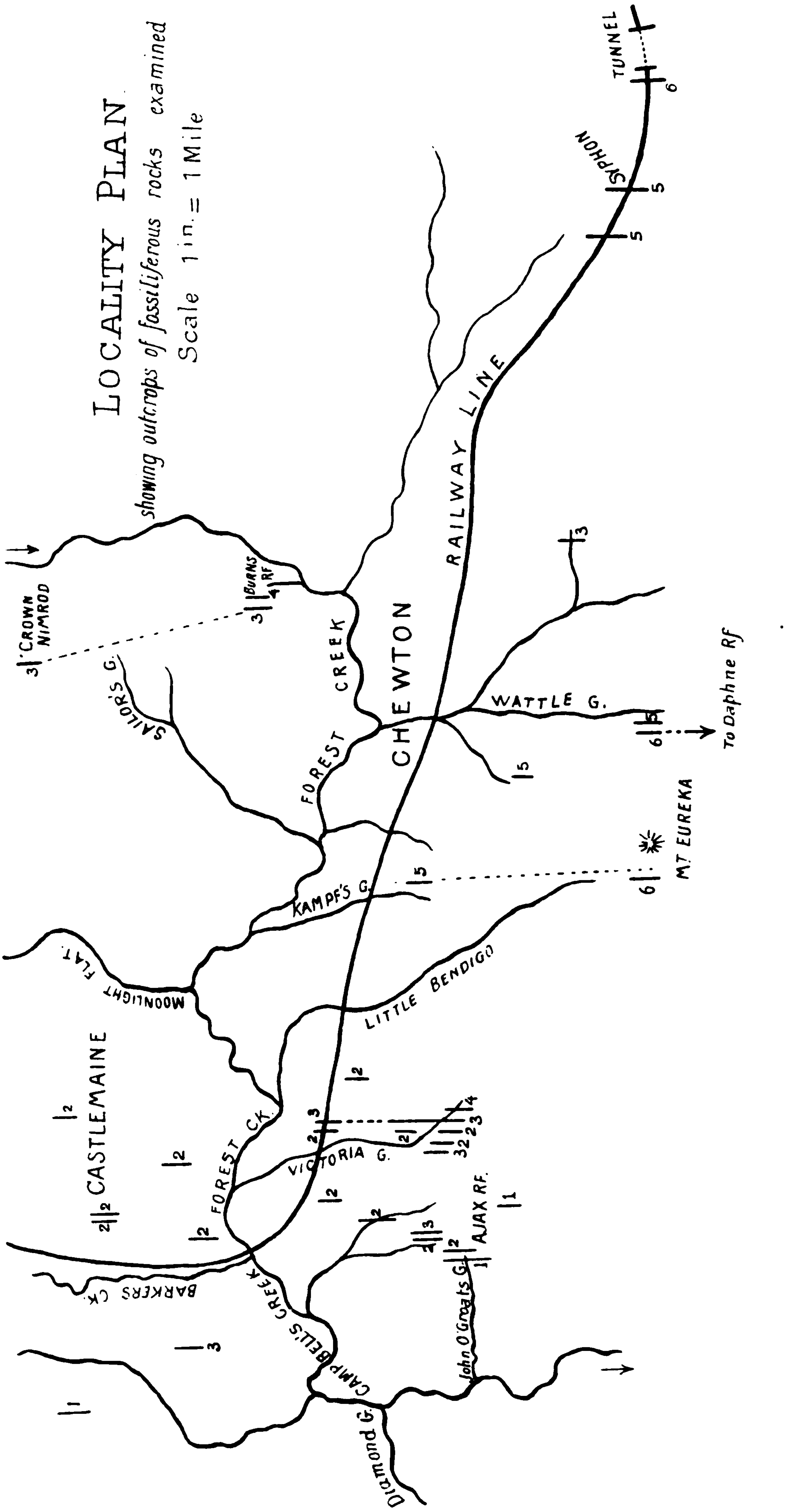
## EXPLANATION OF PLAN.

1.—Outcrops of *L. Logani* zone.
2. „ „ *D. caduceus* zone.
3. „ „ *Phyllograpto-caduceus* zone.
4. „ „ Burns' Reef beds.
5. „ „ Wattle Gully beds.
6. „ „ *T. fruticosus* zone.


LOCALITY PLAN
showing outcrops of fossiliferous rocks examined
Scale 1 in. = 1 Mile
TUNNEL
SYPHON
RAILWAY LINE
CHEWTON
FOREST CREEK
WATTLE G.
To Daphne Rf
MT EUREKA
SAILOR'S G.
CROWN NIMROD
BURNS RF
KAMPF'S G.
LITTLE BENDIGO
MOONLIGHT FLAT
CASTLEMAINE
FOREST CK.
VICTORIA G.
AJAX RF.
BARKERS CK.
CAMPBELL'S CREEK
John O'Groats G.
Diamond G.

## Art. VII.—*The Sugar Strength and Acidity of Victorian Musts, with Reference to the Alcoholic Strength of Victorian Wines.*

Part II.

By W. Percy Wilkinson.

[Communicated by R. L. J. Ellery, Esq., C.M.G., F.R.S., F.R A.S., 10th May, 1894.]

The present, being the second part of an enquiry into the sugar strength and acidity of Victorian musts, is the third part of a general investigation of Victorian wines—the first part of which related solely to the alcoholic strength of Victorian and other Australian wines. In the first part it was shown from the determination of the alcoholic strength of some 600 Australian Wines (*Journal of the Board of Viticulture for Victoria*, May 1892, pp. 81-96), that the average strength of Australian wines is 12 grammes of absolute alcohol per 100 cubic centimetres, as compared to an average of 8 grms. per 100 c.c. characteristic of French and German wines (nearly 2000 samples). In the second part, which was communicated to the Chemical Section of the Aust. Assoc. for Ad. Science, Adelaide, 1893, the investigation of the musts was taken up with a view to ascertaining in the first place whether the sugar strength of Victorian musts was great enough to account for the high alcoholic strength of Victorian (and all Australian) wines, and also to determine how the acidity of Victorian musts compared with those of France and Germany. In the present third part the results of the determinations of sugar strength and acidity of Victorian musts for the Vintage of 1894 are communicated, as it appeared desirable to control the determinations of the vintage of 1893 by a second and more extensive series in a different season and in more widely scattered districts. For the purposes of comparison and completeness the results of 1893 will be reproduced and discussed along with those of 1894.

It was found in the first part that the Victorian wines showed, on the average, an alcoholic strength half as large again as that

of the average French and German wines, for which elaborate data have been published by various French Chemists (Fauré, *Analyse chimique et comparée des Vins de la Gironde;* Gayon, Blarez, and Dubourg, *Analyse chimique des Vins de la Gironde*, 1888; Portes and Ruyssen, *Traité de la Vigne et de ses Produits*, 1886; *Documents du Laboratoire Muncipal;* and analyses by Houdart, Girard, and others given in Viard's *Traité Général de la Vigne et des Vins*, 1892), and the German Imperial Commission for Wine Statistics, appointed in 1884. *(Zeit. für Anal. Chemie.*, 27, *et seq).*

It was shown in the second part that the sugar strength of Victorian musts corresponds closely with the alcoholic strength of Victorian wines, in other words, that the average Victorian must contains nearly half as much sugar again as the average French and German. The determinations for 1894 bear out this interesting result, and show that, on the whole, the alcoholic strength of Victorian wines is fully accounted for by the high sugar strength of the musts. Some earlier investigations of the sugar strength of Australian musts had been made by the Hunter River Vineyard Association, commencing in 1847; Muspratt, 1857, and Dr. A. C. Kelly, 1867, also the South Australian Royal Commission in 1874, and by H. Lumsdaine, Chief Inspector of Distilleries, New South Wales, in 1875, and had proved the high specific gravity and therefore high sugar strength of Australian musts (for instance the South Australian Royal Commission found an average specific gravity of 1·118 for seventeen samples of grapes, representing 28·4 grammes of sugar per 100 cub. cent.) On account of the limited number of the earlier determinations, these two series of 1893 and 1894 were undertaken by me in order to have data as similar as possible to the systematic statistics being gathered for France and Germany, and especially the latter by the labours of the Imperial German Commission.

In the Victorian vintage of 1893 the number of samples of musts examined was 119, while in the present year it was 196, representing the chief wine-growing areas. Each sample was examined on the vineyard where produced, having been pressed by myself, the specific gravity and acidity of each being then taken immediately; the results of the measurements of specific

gravity and acidity are given for all the samples of 1893 and of 1894 in the tables at the end of this paper.

The specific gravities of the musts are referred to a temperature of 15° C., and water at 15° C.; having been determined by the Glucometre of Dr. Guyot. The specific gravity of a must is chiefly useful for giving an approximate value of its sugar strength, which can be derived most conveniently from the specific gravity by means of a table given by Salleron (*Notice sur les instruments de précision appliqués à l'Oenologie*, 1887), showing the relation between the density and sugar strength of a must, Salleron's allowance being made in that table for the effect of matters in the must other than sugar on the specific gravity. This allowance has been obtained as empirically suitable for French musts, and it remains to be ascertained how far it applies accurately to Australian musts, but for present purposes it must be accurate enough. Salleron's table is reproduced at the end of this paper; it should be noticed that in it the alcohol is expressed as the volume of alcohol in 100 volumes of the resulting spirit, whereas in the present paper the alcohol is always expressed as the weight in grammes in 100 cubic centimetres.

With regard to the measurement of acidity, a normal solution of Sodium hydrate (40 grammes of Na.H.O. per litre of solution) was used, with phenolphthalein as indicator for musts from white grapes, and for coloured musts the natural colouring matter of the must was used as indicator (as suggested by Pasteur).

Before comparing the average sugar strength and acidity of Victorian musts with those of the French and German, it will be as well to give separately the averages for 1893 and 1894, as follows :—

TABLE I.

| Year. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free acids, calc. as Tartaric Acid. Grammes per 100 c.c. | Number of Samples. |
|---|---|---|---|---|
| 1893 | 1·108 | 25·8 | ·72 | 119 |
| 1894 | 1·098 | 23·1 | ·79 | 196 |

With these we get the average of all the 315 samples given in the following table, along with the French and German averages:

TABLE II.

| —— | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free acids, calc. as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|
| France - - | 1·083 | 19·1 | ·79 | 4·13 |
| Germany - - | 1·075 | 17·0 | ·96 | 5·65 |
| Victoria - - | 1·102 | 24·2 | ·76 | 3·14 |

It will be seen that although the sugar strength in Victorian musts for 1894 is somewhat lower than in those of 1893, the average strength of Victorian musts is about a third as great again as the French and German averages. The reasons for the slight variation in the Victorian averages for 1893 and 1894 are probably the difference in rainfall, that for 1893 being below, and that for 1894 being above the mean annual value; and the fact that, in order to overtake the greater number of samples of 1894, determinations had to be begun earlier must be borne in mind, as it caused the introduction into the average of a number of samples taken at the earliest stage of the vintage. But under all the conditions it may be said that the two years, 1893 and 1894, taken together have been favourable for giving results which must be close to those that would be obtained by averaging for a number of years.

The most interesting point in connection with the sugar strength of the average Victorian must is the estimation of the amount of alcohol which it can yield in the corresponding wine. According to the chemistry of the alcoholic fermentation of sugar it is allowed that when a solution of sugar is completely fermented the sugar yields almost exactly the half of its own weight of alcohol (strictly 48·6 per cent., see Pasteur, *Ann. de Chimie et de Phys.*, 3rd ser., **58**, p. 330). Accordingly, the 24·2 grammes of sugar in 100 c.c. of average Victorian must would,

on complete fermentation, yield 12·1 grammes of alcohol in 100 c.c. of wine, or more accurately 11·7. Now the average alcoholic strength of Victorion wines, as determined by me in the first part of this investigation, was 12 grammes of alcohol per 100 c.c. of wine, a number practically identical with that just calculated from the sugar strength of the average must; so that the high alcoholic strength of Victorian wines finds its explanation in the high sugar strength of Victorian musts.

With regard to acidity, it is shown in the above table that the acidity of our average Victorian must comes very close to that of the French average, but as the sugar is greater, the proportion of acid to sugar is lower than in the French case; to bring out this difference the column headed parts of acid to 100 parts of sugar has been given above, and it shows that the average Victorian must cannot be said to be simply a more concentrated form of the French and German musts, for while it is more concentrated or stronger as regards sugar it is weaker in acid. As to the amount of acid considered desirable in French and German practice, it is stated by Viard (*Traité Général de la Vigne*, 1892, p. 177), that a must ought not to contain less acid than is equivalent to ·7 to ·9 gramme of tartaric acid per 100 c.c. of must; and Fresenius has given a value nearly ·8 gramme of tartaric acid as characteristic of the must in a good year in Germany; this acidity is almost identical with the Victorian average, but to keep in the same proportion to its high sugar strength the Victorian average ought to be nearly 1·1 gramme of acid per 100 c.c.

The most interesting practical question brought out by these numbers is: Given that it is desirable, how far it is possible to bring the average Victorian wine nearer to the French and German standard? It is obvious that the first condition to be complied with is to bring the average Victorian must nearer to those of France and Germany by a reduction of the sugar strength and an increase of the acidity. That this is possible is proved completely by several individual instances in the tables at the end of this paper; some of which, for convenience, are selected and given separately in the following small table:

TABLE III.

| District Number. | District. | Variety. | Specific Gravity, 15°/15°C. | Sugar. Grammes per 100 c.c. | Free Acids, calc. as Tartaric Acid. Grammes per 100 c.c. | Ratio of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|
| 1 | Tabilk | Carbenet Sauvignon | 1·104 | 24·7 | 1·03 | 4·19 |
| 6 | ,, | Baxter Sherry | 1·094 | 22·0 | 1·03 | 4·71 |
| 8 | ,, | Verdeilho | 1·112 | 26·8 | 1·11 | 4·16 |
| 14 | ,, | Mataro | 1 073 | 16·4 | 1·59 | 9·73 |
| 2 | Barnawartha | Malbeck | 1·088 | 20·4 | 1·08 | 5 30 |
| 7 | ,, | Malbeck | 1·099 | 23·4 | 1·01 | 4·31 |
| 9 | ,, | Carbenet Sauvignon | 1·100 | 23·6 | 1·01 | 4·28 |
| 13 | ,, | Mataro | 1·084 | 19·4 | 1·08 | 5·56 |
| 14 | ,, | Malbeck | 1·096 | 22·6 | 1·01 | 4·46 |
| 15 | ,, | Carbenet Sauvignon | 1·093 | 21·8 | 1·01 | 4·63 |
| 24 | ,, | Riesling | 1·095 | 22·3 | 1·01 | 4·52 |
| 6 | Great Western | Mataro | 1·078 | 17·8 | 1·14 | 6·41 |
| 10 | ,, | Riesling | 1·095 | 22.3 | 1·00 | 4·48 |
| 11 | ,, | Tokay | 1·087 | 20·2 | 1·07 | 5·30 |
| 12 | ,, | Gouais | 1·089 | 20·7 | 1·21 | 5·86 |
| 7 | Yering | Carbenet Sauvignon | 1·090 | 21·0 | 1·00 | 4·76 |
| 10 | ,, | Riesling | 1·090 | 21·0 | 1·14 | 5·44 |
| 11 | Dookie | Riesling | 1·097 | 22·8 | 1·01 | 4·43 |
| 13 | ,, | Baxter Sherry | 1·081 | 18·6 | ·86 | 4·65 |
| 5 | Yackandandah | Riesling | 1·082 | 18·8 | ·86 | 4·61 |
| 21 | ,, | White Hermitage | 1·084 | 19·4 | ·86 | 4·47 |

Some of these are practically identical with the average of French and German musts, and others while stronger in sugar are also stronger in acid, so that the proportion of the two is the same as in the French and German. The question of securing a reduction in sugar strength and an increase in acidity in Victorian musts is connected with another of even greater importance to the Victorian wine growers, namely that of maintaining an approximately constant standard from year to year. In many of the vineyards no accurate scientific methods are used for determining the date of the vintage, the vigneron relying entirely on his own impression as to the fitness of the grapes for gathering; where the experience and judgment are great it is possible that the general impressions of the vigneron may be sufficient to guarantee a practically constant standard of must, but in the general case it would be a great assistance to the vigneron to have measurements taken from day to day of the sugar and acid in the grapes at the approach of the vintage, so that he could start gathering when the quantities were identical with those of some year in which he had obtained his best results. In this way he could secure, at least, the initial conditions for reproducing a wine like his best; of course much depends on the subsequent treatment of the must, but it is impossible that the same treatment, however careful, can give the same results from different musts. The measurements to be made are really simple, many vignerons at present determining the sugar for themselves, and a few both sugar and acids; it is only necessary that the practice of the latter should become more common to produce a greater uniformity in the main ingredients of the wines.

Although there is no doubt that recent researches have proved the powerful influence of the yeast (levure) in determining the character and quality of a wine, and also the importance of the temperature of fermentation, it still remains a fact that the fundamental properties of the wine depend upon the yeasts (levures) having the right material to work on, and it follows that the reasonable course for the vigneron to adopt is to get his must uniform as regards the two main constituents—sugar and acid—as he can easily do. It is evident that different standards will be necessary for different varieties of grapes, but the essential point is that of keeping

scientifically to the standard that has been found best. The same principles that apply to keeping a must uniform from year to year also apply to experiments in varying musts towards the French and German standards, and, as has been already remarked, many vignerons have prepared musts practically identical with those in sugar and acid. It is now assumed amongst the scientific authorities on wine-making that one function of the acids is to contribute to the formation of those ethers (esters) which constitute the bouquet.

Hitherto only the average must of the whole of Victoria has been under discussion, but interest also attaches to a comparison of the variations of the average must in different parts of the country. In the following table are given the averages for the different districts from the individual determinations in Table V. at the end of this paper.

TABLE IV.

VICTORIAN VINTAGE 1893.

MEAN DISTRICT RESULTS.

| District. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|
| Echuca - - | 1·110 | 26·3 | ·72 | 2·72 |
| Tabilk - - - | 1·100 | 23·6 | ·75 | 3·18 |
| Barnawartha - | 1·111 | 26·6 | ·66 | 2·46 |
| Yackandandah - | 1·115 | 27·6 | ·67 | 2·42 |
| Beechworth - - | 1·104 | 24·7 | ·80 | 3·24 |

VINTAGE 1894.

| District. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|
| Echuca - - | 1·101 | 23·9 | ·64 | 2·70 |
| Tabilk - - - | 1·096 | 22·6 | ·86 | 3·83 |
| Barnawatha - - | 1·097 | 22·8 | ·82 | 3·61 |
| Wahgunyah - - | 1·102 | 24·2 | ·74 | 3·07 |
| Dookie - - - | 1·100 | 23·6 | ·75 | 3·20 |
| Yackandandah - | 1·105 | 25·0 | ·71 | 2·86 |
| Great Western - | 1·091 | 21·2 | ·90 | 4·27 |
| Yering - - - | 1·093 | 21·8 | ·87 | 4·01 |

Taking the results for 1894 as covering a larger area, we see that while the actual variation in sugar strength from one district to another is not great, yet the variation in the proportion of acids to sugar is considerable, but even in the sugar strengths there are variations of some importance; these might appear to be due to climatic influence, but I incline to think that differences in practice in the different districts would account largely for such variations as exist; this table shows again what was shown more fully in Table III., that it is possible to exercise a powerful control over the composition of musts.

The collection of the data of this paper for 1894 would have been impossible but for the assistance and hospitality extended to me by the owners and managers of the different vineyards, to whom I beg to offer my heartiest thanks, as also to the Premier, the Hon. J. B. Patterson, for practical encouragement in the work.

In the following Tables, V., VI., pp. 98 to 115, it must be remembered that the Sugar in grammes per 100 cubic centimetres is derived from the specific gravity according to Table VII., pp. 116 and 117, due to Salleron.

## Table V.

## VICTORIAN MUSTS.—VINTAGE 1894.

### NORTHERN GOULBURN VALLEY.—ECHUCA DISTRICT.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | Tongala - | Hermitage - - | Feb. 24 | 1·131 | 31·9 | ·72 | 2·26 |
| 2 | „ - | Hermitage - - | „ „ | 1·104 | 24·7 | ·72 | 2·91 |
| 3 | „ - | Hermitage - - | „ „ | 1·101 | 23·9 | ·72 | 3·01 |
| 4 | „ - | Glory of Australia - | „ „ | 1·095 | 22·3 | ·79 | 3·55 |
| 5 | „ - | Dongelhino - - | „ „ | 1·102 | 24.2 | ·57 | 2·38 |
| 6 | „ - | Black Hambro' - | „ „ | 1·099 | 23·4 | ·43 | 1·84 |
| 7 | „ - | Carbenet Sauvignon | „ „ | 1·100 | 23·6 | ·57 | 2·44 |
| 8 | „ - | Trebbiano - - | „ „ | 1·092 | 21·5 | ·64 | 3·01 |
| 9 | „ - | Verdeilho - - | „ „ | 1·110 | 26·3 | ·79 | 3·01 |
| 10 | „ - | Pedro Ximenes - | „ „ | 1·101 | 23·9 | ·72 | 3·01 |
| 11 | „ - | Gouais - - | Feb. 26 | 1·100 | 23·6 | ·79 | 3·36 |
| 12 | „ - | Terret (Oeillade) - | „ „ | 1·109 | 26·0 | ·43 | 1·66 |
| 13 | „ - | Riesling - - | „ „ | 1·094 | 22·0 | ·72 | 3·30 |
| 14 | „ - | Grenache - - | „ „ | 1·103 | 24·4 | ·57 | 2·30 |
| 15 | „ - | Malbeck - - | „ „ | 1·099 | 23·4 | ·57 | 2·46 |

NORTHERN GOULBURN VALLEY.—ECHUCA DISTRICT—*(Continued).*

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 16 | Tongala - | Mataro - - | Feb. 26 | 1·101 | 23·9 | ·57 | 2·41 |
| 17 | ,, - | Burgundy - - | Feb. 28 | 1·112 | 26 8 | ·50 | 1·88 |
| 18 | Daracombe - | Mataro - - | ,, 27 | 1·104 | 24·7 | ·50 | 2·04 |
| 19 | ,, - | Hermitage - - | ,, ,, | 1·120 | 29·0 | ·57 | 1·98 |
| 20 | Eureka - | Doradillo - - | ,, ,, | 1·087 | 20·2 | ·50 | 2·50 |
| 21 | ,, - | Hermitage - - | ,, ,, | 1·102 | 24·2 | ·64 | 2·65 |
| 22 | ,, - | Terret (Oeillade) - | ,, ,, | 1·087 | 20·2 | ·50 | 2·50 |
| 23 | ,, - | Riesling - - | ,, ,, | 1·086 | 19·9 | ·79 | 3·98 |
| 24 | Newcombe - | Hermitage - - | Feb. 28 | 1·106 | 25·2 | ·72 | 2·86 |
| 25 | ,, - | Mataro - - | ,, ,, | 1·084 | 19·4 | ·79 | 4·08 |
| 26 | ,, - | Riesling - - | ,, ,, | 1·094 | 22·0 | ·86 | 3 93 |
| 27 | St. Helena - | Pedro Ximenes - | ,, ,, | 1·106 | 25·2 | ·64 | 2·57 |
| 28 | ,, - | Terret (Oeillade) - | ,, ,, | 1·114 | 27·4 | ·57 | 2·10 |
| 29 | ,, - | Mataro - - | ,, ,, | 1 107 | 25·5 | ·50 | 1 98 |
| 30 | ,, - | Hermitage - - | ,, ,, | 1·107 | 25·5 | ·72 | 2·82 |
| 31 | ,, - | Riesling - - | ,, ,, | 1·099 | 23·4 | ·79 | 3·38 |
| | | | Mean - | 1·101 | 23·9 | ·64 | 2·70 |
| | | | Max. - | 1·131 | 31·9 | ·79 | 4·08 |
| | | | Min. - | 1·084 | 19·4 | ·43 | 1·66 |

## SOUTHERN GOULBURN VALLEY.—TABILK DISTRICT.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15°C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | Château Tabilk - | Carbenet Sauvignon | March 27 | 1·104 | 24·7 | 1·03 | 4·19 |
| 2 | ,, - | Chasselas - - | ,, ,, | 1·095 | 22·3 | ·47 | 2·14 |
| 3 | ,, - | Mataro - - | ,, ,, | 1·094 | 22·0 | ·71 | 3·26 |
| 4 | ,, - | Hermitage - - | ,, ,, | 1·108 | 25·8 | ·79 | 3·09 |
| 5 | ,, - | White Hermitage - | ,, ,, | 1·103 | 24·4 | ·87 | 3·59 |
| 6 | ,, - | Baxter Sherry - | ,, ,, | 1·094 | 22·0 | 1·03 | 4·71 |
| 7 | ,, - | Riesling - - | ,, ,, | 1·091 | 21·2 | ·71 | 3·38 |
| 8 | Goulburn Valley | Verdeilho - - | ,, ,, | 1·112 | 26·8 | 1·11 | 4·16 |
| 9 | ,, - | Carbenet Sauvignon | ,, ,, | 1·093 | 21·8 | ·87 | 4·02 |
| 10 | ,, - | Pineau blanc - | ,, ,, | 1·091 | 21·2 | ·79 | 3·76 |
| 11 | ,, - | Chasselas - - | ,, ,, | 1·107 | 25·5 | ·55 | 2·18 |
| 12 | ,, - | Riesling - - | ,, ,, | 1·090 | 21·0 | ·95 | 4·56 |
| 13 | ,, - | Doradillo - - | ,, ,, | 1·090 | 21·0 | ·55 | 2·66 |
| 14 | ,, - | Mataro - - | ,, ,, | 1·078 | 16·4 | 1·59 | 9·73 |
| | | | Mean - | 1·096 | 22·6 | ·86 | 3·83 |
| | | | Max. - | 1·112 | 26·8 | 1·59 | 9·73 |
| | | | Min. - | 1·073 | 16·4 | ·47 | 2·14 |

## WAHGUNYAH DISTRICT.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | All Saints | Hermitage | March 26 | 1·098 | 23·1 | ·79 | 3·45 |
| 2 | ,, | Gouais | ,, ,, | 1·090 | 21·0 | ·71 | 3·42 |
| 3 | ,, | Pedro Ximenes | ,, ,, | 1·110 | 26·3 | ·79 | 3·03 |
| 4 | ,, | Aucarot | ,, ,, | 1·100 | 23·6 | ·55 | 2·36 |
| 5 | ,, | Verdeilho | ,, ,, | 1·115 | 27·6 | ·79 | 2·89 |
| 6 | ,, | Malbeck | ,, ,, | 1·106 | 25·2 | ·71 | 2·84 |
| 7 | ,, | Riesling | ,, ,, | 1·097 | 22·8 | ·71 | 3·14 |
| 8 | ,, | Grenache | ,, ,, | 1·093 | 21·8 | ·79 | 3·66 |
| 9 | ,, | Tokay | ,, ,, | 1·113 | 27·1 | ·71 | 2·64 |
| 10 | ,, | Chasselas | ,, ,, | 1·095 | 22·3 | ·55 | 2·50 |
| 11 | ,, | Carbenet Sauvignon | ,, ,, | 1·100 | 23·6 | ·79 | 3·38 |
| 12 | ,, | Brown Muscat | ,, ,, | 1·112 | 26·8 | ·95 | 3·57 |
| | | | Mean | 1·102 | 24·2 | ·74 | 3·07 |
| | | | Max. | 1·115 | 27·6 | ·95 | 3·66 |
| | | | Min. | 1·090 | 21·0 | ·55 | 2·50 |

## BARNAWARTHA DISTRICT.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | Bordeaux - | Brown Muscat - | March 9 | 1·093 | 21·8 | ·79 | 3·64 |
| 2 | ,, - | Malbeck - - | ,, ,, | 1·088 | 20·4 | 1·08 | 5·30 |
| 3 | Barnawartha - | Brown Muscat - | ,, ,, | 1·106 | 25·2 | ·79 | 3 14 |
| 4 | ,, - | Grenache - - | ,, ,, | 1·100 | 23·6 | ·86 | 3·66 |
| 5 | ,, - | Riesling - - | ,, ,, | 1·095 | 22·3 | ·93 | 4·20 |
| 6 | ,, - | Verdeilho - - | ,, ,, | 1·114 | 27·4 | ·93 | 3·42 |
| 7 | ,, - | Malbeck - - | ,, ,, | 1·099 | 23·4 | 1·01 | 4·31 |
| 8 | ,, - | Hermitage - - | ,, ,, | 1·091 | 21·2 | ·86 | 4·08 |
| 9 | ,, - | Carbenet Sauvignon | ,, ,, | 1·100 | 23·6 | 1·01 | 4·28 |
| 10 | ,, - | Aucarot - - | ,, ,, | 1·112 | 26·8 | ·86 | 3·22 |
| 11 | Burrabunnia - | Hermitage - - | March 10 | 1·087 | 20 2 | ·93 | 4·63 |
| 12 | ,, - | Brown Muscat - | ,, ,, | 1·096 | 22 6 | ·64 | 2·87 |
| 13 | ,, - | Mataro - - | ,, ,, | 1·084 | 19·4 | 1·08 | 5·56 |
| 14 | ,, - | Malbeck - - | ,, ,, | 1·096 | 22·6 | 1·01 | 4·46 |
| 15 | ,, - | Carbenet Sauvignon | ,, ,, | 1·093 | 21 8 | 1·01 | 4·63 |
| 16 | Rocky Point - | Brown Muscat - | March 11 | 1·082 | 18·8 | ·79 | 4·21 |
| 17 | ,, - | Chasselas - - | ,, ,, | 1·095 | 22·3 | ·50 | 2·26 |
| 18 | ,, - | Malbeck - - | ,, ,, | 1·101 | 23·9 | ·86 | 3·61 |
| 19 | ,, - | Riesling - - | ,, ,, | 1·098 | 22·6 | ·98 | 4·14 |

BARNAWARTHA DISTRICT—*(Continued)*.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15°C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 20 | Rocky Point - | Pineau blanc - | March 11 | 1·107 | 25·5 | ·64 | 2.54 |
| 21 | ,, - | Gouais - - | ,, ,, | 1·083 | 19·1 | ·93 | 4·90 |
| 22 | ,, - | White Hermitage - | ,, ,, | 1·083 | 19·1 | ·93 | 4·90 |
| 23 | ,, - | Hermitage - - | ,, ,, | 1·101 | 23·9 | ·79 | 3·31 |
| 24 | Koendidda - | Riesling - - | ,, ,, | 1·095 | 22·3 | 1·01 | 4·52 |
| 25 | ,, - | Malbeck - - | ,, ,, | 1·106 | 25·2 | ·86 | 3·43 |
| 26 | ,, - | Hermitage - - | ,, ,, | 1·106 | 25·2 | ·72 | 2·86 |
| 27 | ,, - | Brown Muscat - | ,, ,, | 1·103 | 24·4 | ·86 | 3·54 |
| 28 | Fassifern - | Malaga - - | ,, ,, | 1·088 | 20·4 | ·57 | 2·82 |
| 29 | ,, - | Gordo Blanco - | ,, ,, | 1·121 | 29·2 | ·43 | 1·47 |
| 30 | Somerset - | Chasselas - - | ,, ,, | 1·085 | 19·6 | ·57 | 2·93 |
| 31 | ,, - | Malbeck - - | ,, ,, | 1·107 | 25·5 | ·72 | 2·82 |
| 32 | ,, - | Hermitage - - | ,, ,, | 1·105 | 25·0 | ·64 | 2·59 |
| 33 | ,, - | Riesling - - | ,, ,, | 1·100 | 23·6 | ·72 | 3·05 |
| | | | Mean - | 1·097 | 22·8 | ·82 | 3·61 |
| | | | Max. - | 1·121 | 29·2 | 1·08 | 5·56 |
| | | | Min. - | 1·082 | 18·8 | ·43 | 1·47 |

## YACKANDANDAH DISTRICT.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | Melville - | Aucarot - - | April 7 | 1 115 | 27·6 | ·71 | 2·57 |
| 2 | ,, - | Brown Muscat - | ,, ,, | 1·122 | 29·5 | ·71 | 2·40 |
| 3 | ,, - | Burgundy - - | ,, ,, | 1·124 | 30·0 | ·78 | 2·93 |
| 4 | ,, - | Verdeilho - - | ,, ,, | 1·124 | 30·0 | ·71 | 2·36 |
| 5 | Biddington - | Riesling - - | ,, ,, | 1·082 | 18·8 | ·86 | 4·61 |
| 6 | ,, - | Brown Muscat - | ,, ,, | 1·105 | 25·0 | ·78 | 3·15 |
| 7 | ,, - | Madeira - - | April 8 | 1·084 | 19·4 | ·55 | 2·85 |
| 8 | ,, - | Pineau gris - - | ,, ,, | 1·107 | 25·5 | ·55 | 2·16 |
| 9 | ,, - | Burgundy - - | ,, ,, | 1·102 | 24 2 | ·78 | 3·26 |
| 10 | ,, - | Hermitage - - | ,, ,, | 1·099 | 23 4 | ·55 | 2 36 |
| 11 | Staghorn - | Brown Muscat - | ,, ,, | 1·108 | 25·8 | ·63 | 2.44 |
| 12 | ,, - | Hermitage - - | ,, ,, | 1·108 | 25·8 | ·71 | 2·75 |
| 13 | ,, - | Verdeilho - - | ,, ,, | 1·115 | 27·6 | ·86 | 3·14 |
| 14 | Westmoreland - | Burgundy - - | ,, ,, | 1 111 | 26·6 | ·71 | 2·67 |
| 15 | ,, - | Verdeilho - - | ,, ,, | 1·123 | 29 8 | ·63 | 2·11 |
| 16 | ,, - | Hermitage - - | ,, ,, | 1·101 | 23·9 | ·71 | 2·97 |
| 17 | ,, - | Brown Muscat - | ,, ,, | 1·114 | 27·4 | ·63 | 2·30 |
| 18 | ,, - | Riesling - - | ,, ,, | 1 101 | 23·9 | ·63 | 2·64 |
| 19 | Ivyton - | Hermitage - - | ,, ,, | 1·119 | 28·7 | ·71 | 2·47 |
| 20 | ,, - | Reisling - - | ,, ,, | 1·088 | 20·4 | ·86 | 4.26 |
| 21 | Balmoral - | White Hermitage - | ,, ,, | 1·084 | 19·4 | ·86 | 4·47 |
| 22 | ,, - | Mataro - - | ,, ,, | 1·090 | 21·0 | ·71 | 3·40 |
| 23 | ,, - | Malbeck - - | ,, ,, | 1·104 | 24·7 | ·86 | 3·51 |
| 24 | ,, - | Hermitage - - | ,, ,, | 1·101 | 23 9 | 63 | 2·64 |
| | | | Mean - | 1·105 | 25·0 | ·71 | 2·86 |
| | | | Max. - | 1·124 | 30·0 | ·86 | 4·61 |
| | | | Min. - | 1·082 | 18·8 | ·55 | 2·11 |

## GREAT WESTERN DISTRICT.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | Great Western - | Hermitage - - | March 17 | 1·097 | 22·8 | ·92 | 4·07 |
| 2 | ,, - | Carbenet Sauvignon | ,, ,, | 1.095 | 22·3 | ·71 | 3·20 |
| 3 | ,, - | Malbeck - - | ,, ,, | 1·092 | 21·5 | ·85 | 4·00 |
| 4 | ,, - | Pineau noir - - | ,, ,, | 1·099 | 23·4 | 1·00 | 4 27 |
| 5 | ,, - | Burgundy - - | ,, ,, | 1·087 | 20·2 | ·85 | 4·24 |
| 6 | ,, - | Mataro - - | ,, ,, | 1·078 | 17·8 | 1·14 | 6·41 |
| 7 | ,, - | Espart - - | ,, ,, | 1·084 | 19·4 | 1·00 | 5·15 |
| 8 | ,, - | Red Frontignac - | ,, ,, | 1·096 | 22·6 | 1·00 | 4·42 |
| 9 | ,, - | Pineau blanc - | ,, ,, | 1·095 | 22·3 | ·71 | 3·20 |
| 10 | ,, - | Riesling - - | ,, ,, | 1·095 | 22·3 | 1·00 | 4·48 |
| 11 | ,, - | Tokay - - | ,, ,, | 1·087 | 20·2 | 1·07 | 5·30 |
| 12 | ,, - | Gouais - - | ,, ,, | 1·089 | 20·7 | 1·21 | 5·86 |
| 13 | ,, - | Sweetwater - - | ,, ,, | 1·083 | 19·1 | ·71 | 3·73 |
| 14 | ,, - | Chasselas - - | ,, ,, | 1·081 | 18·6 | ·64 | 3·45 |
| 15 | ,, - | White Frontignac - | ,, ,, | 1·087 | 20·2 | 1·21 | 6·00 |
| 16 | ,, - | Black Prince - | ,, ,, | 1·089 | 20·7 | ·78 | 3·79 |
| 17 | ,, - | Pedro Ximenes - | ,, ,, | 1·090 | 21·0 | ·92 | 4·42 |
| 18 | ,, - | Muscat of Alexandria | ,, ,, | 1·079 | 18·0 | ·78 | 4·35 |
| 19 | St. Ethels - | Mataro - - | March 18 | 1·102 | 24·2 | ·85 | 3·45 |
| 20 | ,, - | Grenache - - | ,, ,, | 1·102 | 24·2 | ·92 | 3·83 |
| 21 | ,, - | Burgundy - - | ,, ,, | 1·101 | 23·9 | ·85 | 3·60 |
| 22 | ,, - | Malbeck - - | ,, ,, | 1·083 | 19·1 | ·92 | 4·85 |
| 23 | ,, - | Hermitage - - | ,, ,, | 1·102 | 24·2 | 1·00 | 4·13 |
| 24 | ,, - | Chasselas - - | ,, ,, | 1·099 | 23·4 | ·64 | 2·74 |
| | | | Mean - | 1·091 | 21·2 | ·90 | 4·27 |
| | | | Max. - | 1·102 | 24·2 | 1·21 | 6·41 |
| | | | Min. - | 1·078 | 17·8 | ·64 | 3·20 |

## DOOKIE DISTRICT.

| Progressive Number | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15° C. | Sugar, Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | Fairburn Grange | Black Hambro' | March 7 | 1·096 | 22·6 | ·86 | 3·82 |
| 2 | ,, | Pedro Ximenes | ,, ,, | 1·098 | 23·1 | ·93 | 4·05 |
| 3 | ,, | Black Prince | ,, ,, | 1·093 | 21·8 | 1·01 | 4·63 |
| 4 | ,, | Chasselas | ,, ,, | 1·096 | 22·6 | ·50 | 2·23 |
| 5 | ,, | Carbonet Sauvignon | ,, ,, | 1·105 | 25·0 | ·86 | 3·46 |
| 6 | ,, | Baxter Sherry | ,, ,, | 1·088 | 20·4 | ·79 | 3·88 |
| 7 | ,, | Hermitage | ,, ,, | 1·099 | 23·4 | ·79 | 3·38 |
| 8 | ,, | Gordo Blanco | ,, ,, | 1·094 | 22·0 | ·79 | 3·60 |
| 9 | ,, | Gouais | ,, ,, | 1·092 | 21·5 | ·79 | 3·68 |
| 10 | ,, | Hermitage | ,, ,, | 1·105 | 25·0 | ·79 | 3·17 |
| 11 | ,, | Riesling | ,, ,, | 1·097 | 22·8 | 1·01 | 4·43 |
| 12 | ,, | Gordo Blanco | March 13 | 1·089 | 20·7 | ·57 | 2·78 |
| 13 | ,, | Baxter Sherry | ,, ,, | 1·081 | 18·6 | ·86 | 4·65 |
| 14 | ,, | Hermitage | ,, ,, | 1·112 | 26·8 | ·79 | 2·95 |
| 15 | ,, | Riesling | ,, ,, | 1·104 | 24·7 | ·86 | 3·50 |
| 16 | ,, | Black Hambro' | ,, ,, | 1·091 | 21·2 | ·86 | 4·22 |
| 17 | ,, | Carbenet Sauvignon | ,, ,, | 1·106 | 25·2 | 1·01 | 4·00 |
| 18 | ,, | Gordo Blanco | ,, ,, | 1·109 | 26·0 | 64 | 2·49 |
| 19 | ,, | Riesling | ,, ,, | 1·109 | 26·0 | ·79 | 3·05 |
| 20 | ,, | Pedro Ximenes | ,, ,, | 1·111 | 26·6 | ·79 | 3.00 |
| 21 | ,, | Gouais | ,, ,, | 1 112 | 26·8 | 64 | 2·41 |
| 22 | ,, | Black Prince | ,, ,, | 1·098 | 23·1 | ·86 | 3·74 |
| 23 | Koimburra | Malaga | March 14 | 1·102 | 24·2 | ·36 | 1·48 |
| 24 | ,, | Gordo Blanco | ,, ,, | 1·099 | 23·4 | ·57 | 2 46 |
| 25 | ,, | Black Hambro' | ,, ,, | 1·075 | 17·0 | ·64 | 3·81 |

DOOKIE DISTRICT—*(Continued)*.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15°C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 26 | Koimburra - | Black Prince - | March 14 | 1·086 | 19·9 | ·79 | 4·00 |
| 27 | „ - | Black St. Peter - | „ „ | 1·090 | 21·0 | ·79 | 3·77 |
| 28 | „ - | Baxter Sherry - | „ „ | 1·086 | 19.9 | ·79 | 4·00 |
| 29 | Dookie College - | Gordo Blanco - | „ „ | 1·096 | 22·6 | ·57 | 2·54 |
| 30 | „ - | Carbenet Sauvignon | „ „ | 1·116 | 27·9 | ·79 | 2·84 |
| 31 | „ - | Hermitage - - | „ „ | 1·130 | 31·6 | ·64 | 2·05 |
| 32 | Château Dookie - | Shepherd's Riesling - | „ „ | 1·110 | 26·3 | ·64 | 2·47 |
| 33 | „ - | Mataro - - | „ „ | 1·106 | 25·2 | ·86 | 3·43 |
| 34 | „ - | Gouais - - | „ „ | 1·097 | 22·8 | ·86 | 3·78 |
| 35 | „ - | Pedro Ximenes - | „ „ | 1·109 | 26·0 | ·64 | 2·49 |
| 36 | „ - | Hermitage - - | „ „ | 1·117 | 28·2 | ·72 | 2·55 |
| 37 | „ - | Chasselas - - | „ „ | 1·103 | 24·4 | ·50 | 2·07 |
| 38 | „ - | Tokay - - | „ „ | 1·101 | 23·9 | ·64 | 2·71 |
| 39 | „ - | White Hermitage - | „ „ | 1·096 | 22·6 | ·79 | 3·51 |
| 40 | Stoneleigh - | Carbenet Sauvignon | „ „ | 1·108 | 25·8 | ·79 | 3·07 |
| 41 | „ - | White Hermitage - | „ „ | 1·110 | 26·3 | ·57 | 2·20 |
| 42 | „ - | Malbeck - - | „ „ | 1·103 | 24·4 | ·72 | 2·95 |
| 43 | „ - | Riesling - - | „ „ | 1·100 | 23·6 | ·79 | 3·36 |
| | | | Mean - | 1·100 | 23·6 | ·75 | 3·20 |
| | | | Max. - | 1·130 | 31·6 | 1·01 | 4·63 |
| | | | Min. - | 1·075 | 17·0 | ·36 | 1·48 |

## YERING DISTRICT.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15°C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | Yering - | Hermitage - - | March 22 | 1·090 | 21 0 | ·85 | 4·08 |
| 2 | ,, - | Merlot - - | ,, ,, | 1·092 | 21·5 | 1·28 | 5·95 |
| 3 | ,, - | White Hermitage - | ,, ,, | 1·101 | 23·9 | ·78 | 3·28 |
| 4 | ,, - | Mataro - - | ,, ,, | 1·085 | 19·6 | ·92 | 4·73 |
| 5 | ,, - | Pineau blanc - | ,, ,, | 1·095 | 22·3 | ·78 | 3·52 |
| 6 | ,, - | Pineau gris - - | ,, ,, | 1·104 | 24·7 | ·71 | 2·87 |
| 7 | ,, - | Carbenet Sauvignon | ,, ,, | 1·090 | 21·0 | 1·00 | 4·76 |
| 8 | ,, - | Malbeck - - | ,, ,, | 1·095 | 22·3 | ·85 | 3·84 |
| 9 | ,, - | Gouais - - | ,, ,, | 1·077 | 17·5 | 1·07 | 6·12 |
| 10 | ,, - | Riesling - - | ,, ,, | 1·090 | 21·0 | 1·14 | 5·44 |
| 11 | St. Huberts - | Hermitage - - | ,, ,, | 1·101 | 23·9 | ·78 | 3·28 |
| 12 | ,, - | Carbenet Sauvignon | ,, ,, | 1·092 | 21·5 | ·78 | 3·65 |
| 13 | ,, - | Chasselas - - | ,, ,, | 1·088 | 20·4 | ·57 | 2·80 |
| 14 | ,, - | White Hermitage - | ,, ,, | 1·098 | 23·1 | ·64 | 2·78 |
| 15 | ,, - | Riesling - - | ,, ,, | 1·100 | 23·6 | ·92 | 3·93 |
| | | | Mean - | 1·093 | 21·8 | ·87 | 4·01 |
| | | | Max. - | 1·104 | 24·7 | 1·28 | 5·95 |
| | | | Min. - | 1·077 | 17·5 | ·57 | 2·78 |

# VINTAGE 1893.

## NORTHERN GOULBURN VALLEY.—ECHUCA DISTRICT.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | Tongala - | Muscat Red - - | March 9 | 1·124 | 30·0 | ·34 | 1·13 |
| 2 | ,, - | Muscat Red - - | ,, 12 | 1·160 | 39·0 | ·70 | 1·80 |
| 3 | ,, - | Burgundy - - | ,, 9 | 1·125 | 30·3 | ·76 | 2·50 |
| 4 | ,, - | Burgundy - - | ,, 10 | 1·113 | 27·1 | ·75 | 2·77 |
| 5 | ,, - | Burgundy - - | ,, 11 | 1·144 | 35·4 | 1·12 | 3·16 |
| 6 | ,, - | Burgundy - - | ,, 11 | 1·140 | 34·3 | ·76 | 2·22 |
| 7 | ,, - | Pedro Ximenes - | ,, 10 | 1·093 | 21·8 | ·82 | 3·76 |
| 8 | ,, - | Verdeilho - - | ,, 10 | 1·108 | 25·8 | ·86 | 3·33 |
| 9 | ,, - | Terret Oeillade - | ,, 10 | 1·096 | 22·6 | ·76 | 3 36 |
| 10 | ,, - | Riesling - - | ,, 11 | 1·092 | 21·5 | ·82 | 3·81 |
| 11 | ,, - | Riesling - - | ,, 14 | 1·096 | 22·6 | ·76 | 3·36 |
| 12 | ,, - | Riesling - - | ,, 17 | 1·101 | 23·9 | ·75 | 3·14 |
| 13 | ,, - | Carbenet Sauvignon | ,, 12 | 1·117 | 28·2 | ·75 | 2·66 |
| 14 | ,, - | Hermitage - - | ,, 12 | 1·124 | 30·0 | ·82 | 2·73 |
| 15 | ,, - | Dongelhino - - | ,, 12 | 1·116 | 27·9 | ·86 | 3·08 |
| 16 | ,, - | Black St. Peter - | ,, 12 | 1·088 | 20·4 | ·60 | 2·94 |
| 17 | ,, - | Unknown - - | ,, 12 | 1·116 | 27·9 | ·75 | 2·68 |
| 18 | ,, - | Malbeck - - | ,, 13 | 1·112 | 26·8 | ·75 | 2·77 |
| 19 | ,, - | Carignane - - | ,, ,, | 1·094 | 22·0 | ·62 | 2·82 |
| 20 | ,, - | Unknown - - | ,, ,, | 1·133 | 32·4 | ·80 | 2·47 |
| 21 | ,, - | Chasselas - - | ,, ,, | 1·107 | 25·5 | ·45 | 1·76 |

NORTHERN GOULBURN VALLEY.—ECHUCA DISTRICT—*(Continued).*

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15°C. | Sugar Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 22 | Tongala - | Terret & Hermitage - | March 13 | 1·114 | 27·4 | ·62 | 2·26 |
| 23 | „ - | Black Prince - | „ „ | 1·096 | 22·6 | ·75 | 3·32 |
| 24 | „ - | Grenache - - | March 15 | 1·120 | 29·0 | ·76 | 2·62 |
| 25 | „ - | Doradillo - - | „ „ | 1·094 | 22·0 | ·41 | 1·87 |
| 26 | „ - | Sultana - - | „ „ | 1·120 | 29·0 | ·62 | 2·14 |
| 27 | „ - | Sweet-water - - | „ „ | 1·100 | 23·6 | ·75 | 3·17 |
| 28 | „ - | Trebbiano - - | „ „ | 1·114 | 27·4 | ·65 | 2·37 |
| 29 | „ - | Mataro & Hermitage | March 16 | 1·117 | 28·2 | ·62 | 2·20 |
| 30 | Daracombe - | Mataro - - | „ 10 | 1·096 | 22·6 | 1·12 | 4·95 |
| 31 | Killarney - | Mataro - - | „ 11 | 1·106 | 25·2 | ·62 | 2·46 |
| 32 | „ - | Hermitage - - | „ 11 | 1·107 | 25·5 | ·76 | 3·00 |
| 33 | Newcombe - | Hermitage - - | „ 15 | 1·123 | 29·8 | ·76 | 2·55 |
| 34 | „ - | Riesling - - | „ 17 | 1·100 | 23·6 | ·65 | 2·80 |
| 35 | St. Helena - | Hermitage - - | „ 15 | 1·116 | 27·9 | ·65 | 2·30 |
| 36 | „ - | Morellion - - | „ 17 | 1·080 | 18·3 | ·75 | 4·10 |
| 37 | „ - | Terret - - | „ „ | 1·116 | 27·9 | ·55 | 2·00 |
| 38 | „ - | Black Prince - | „ „ | 1·090 | 21·0 | ·62 | 3·00 |
| 39 | „ - | Mataro - - | „ „ | 1·130 | 31·6 | ·62 | 1·96 |
| 40 | „ - | Black St. Peter - | „ „ | 1·084 | 19·4 | ·76 | 3·91 |
| 41 | Eureka - | Terret - - | March 18 | 1·100 | 23·6 | ·75 | 3·18 |
| | | | Mean - | 1·110 | 26·3 | ·72 | 2·72 |
| | | | Max. - | 1·160 | 39·0 | 1·12 | 4·95 |
| | | | Min. - | 1·080 | 18·3 | ·34 | 1·13 |

## SOUTHERN GOULBURN VALLEY.—TABILK DISTRICT.

| Progressive Number. | Name of Vineyard | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | Château Tabilk - | White Hermitage - | April 8 | 1·100 | 26·0 | ·75 | 2·90 |
| 2 | „ - | Riesling - - | „ „ | 1·095 | 22·3 | ·90 | 4·03 |
| 3 | „ - | Gouais - - | „ „ | 1·091 | 21·2 | ·82 | 3·86 |
| 4 | „ - | Hermitage - - | „ „ | 1·100 | 23·6 | ·92 | 3·90 |
| 5 | „ - | Black Prince - | „ „ | 1·081 | 18 6 | ·62 | 3·33 |
| 6 | „ - | Pedro Ximenes - | „ „ | 1·074 | 16·7 | ·45 | 2·70 |
| 7 | Goulburn Valley - | Doradillo - - | „ „ | 1·065 | 14·3 | ·48 | 3·35 |
| 8 | „ - | Chasselas - - | „ „ | 1·100 | 23 6 | ·52 | 2·20 |
| 9 | „ - | Verdeilho - - | „ „ | 1·116 | 27·9 | ·85 | 3·05 |
| 10 | „ - | Hermitage - - | „ „ | 1·116 | 27 9 | ·82 | 2·93 |
| 11 | „ - | Mataro - - | „ „ | 1·103 | 24·4 | ·85 | 3·48 |
| 12 | „ - | Black Hambro' - | „ „ | 1·130 | 31·6 | ·92 | 2·90 |
| 13 | „ - | Muscat - - | „ „ | 1·150 | 37·0 | ·95 | 2·57 |
| 14 | Cameron's - | Burgundy - - | April 9 | 1·107 | 25·5 | ·92 | 3·60 |
| 15 | „ - | Muscatel, white - | „ „ | 1·095 | 22·3 | ·75 | 3·36 |
| 16 | „ - | Muscatel, brown - | „ „ | 1·088 | 20·4 | ·85 | 4·16 |
| 17 | „ - | Mataro - - | „ „ | 1·099 | 23·4 | ·65 | 2·77 |
| 18 | „ - | Hermitage - - | „ „ | 1·122 | 29·5 | ·75 | 2·54 |
| 19 | „ - | Black Hambro' - | „ „ | 1·101 | 23·9 | ·88 | 3·68 |
| 20 | „ - | Black Prince - | „ „ | 1·092 | 21·5 | ·68 | 3·16 |
| 21 | „ - | Riesling - - | „ „ | 1 101 | 23·9 | ·75 | 3·14 |
| 22 | „ - | Chasselas - - | „ „ | 1·092 | 21·5 | ·55 | 2 56 |
| 23 | „ - | Pedro Ximenes - | „ „ | 1·091 | 21 2 | ·55 | 2·60 |
| 24 | „ - | Baxter Sherry - | „ „ | 1·094 | 22·0 | ·82 | 3·73 |
| | | | Mean - | 1·100 | 23·6 | ·75 | 3·18 |
| | | | Max. - | 1·150 | 37·0 | ·95 | 4 16 |
| | | | Min. - | 1·074 | 16·7 | ·45 | 2·20 |

## BARNAWARTHA DISTRICT.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15°C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | Bordeaux - | Malbeck - - | March 27 | 1·104 | 24·7 | ·75 | 3·03 |
| 2 | ,, - | Hermitage - - | ,, ,, | 1·109 | 26·0 | ·92 | 3·54 |
| 3 | Fairview - | Muscat - - | ,, ,, | 1·158 | 38·6 | ·72 | 1·86 |
| 4 | ,, - | Malbeck - - | ,, ,, | 1·117 | 28·2 | ·58 | 2·05 |
| 5 | Mundadda - | Riesling - - | March 28 | 1·112 | 26·8 | ·50 | 1·86 |
| 6 | ,, - | Gouais - - | ,, ,, | 1·100 | 23·6 | ·58 | 2·45 |
| 7 | ,, - | White Hermitage - | ,, ,, | 1·112 | 26·8 | ·56 | 2·10 |
| 8 | ,, - | Baxter Sherry - | ,, ,, | 1·086 | 19·9 | ·53 | 2·66 |
| 9 | ,, - | Chasselas - - | ,, ,, | 1·104 | 24·7 | ·53 | 2·14 |
| 10 | ,, - | Hermitage - - | ,, ,, | 1·123 | 29.8 | ·73 | 2·45 |
| 11 | ,, - | Malbeck - - | ,, ,, | 1·106 | 25·2 | ·67 | 2·65 |
| 12 | ,, - | Mataro - - | ,, ,, | 1·103 | 24·4 | ·67 | 2·74 |
| 13 | Wakefield - | Malbeck - - | ,, ,, | 1·112 | 26·8 | ·73 | 2·72 |
| 14 | ,, - | Hermitage - - | ,, ,, | 1·126 | 30·6 | ·80 | 2·61 |
| 15 | Somerset - | Malbeck - - | ,, ,, | 1·116 | 27·9 | ·70 | 2·51 |
| 16 | ,, - | Riesling - - | ,, ,, | 1·101 | 23·9 | ·61 | 2 55 |
| 17 | ,, - | Chasselas - - | ,, ,, | 1·092 | 21·5 | ·53 | 2·46 |
| 18 | Barnawartha - | Sweet water - - | March 29 | 1·100 | 23·6 | ·45 | 1·90 |
| 19 | ,, - | Gouais - - | ,, ,, | 1·091 | 21·2 | ·61 | 2·88 |
| 20 | ,, - | Chasselas - - | ,, ,, | 1·083 | 19·1 | ·41 | 2·14 |

BARNAWARTHA DISTRICT—*(Continued)*.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 21 | Barnawartha - | Malbeck - - | March 29 | 1·121 | 29·2 | ·70 | 2·40 |
| 22 | ,, - | Muscat - - | ,, ,, | 1·150 | 37·0 | ·83 | 2·24 |
| 23 | ,, - | Isabella - - | ,, ,, | 1·102 | 24·2 | ·58 | 2·40 |
| 24 | ,, - | White Hermitage - | ,, ,, | 1·102 | 24·2 | ·70 | 2·90 |
| 25 | ,, - | Aucarot - - | ,, ,, | 1·130 | 31·6 | ·70 | 2·21 |
| 26 | ,, - | Verdeilho - - | ,, ,, | 1·123 | 29·8 | ·75 | 2·51 |
| 27 | ,, - | Hermitage - - | ,, ,, | 1·132 | 32·2 | ·77 | 2·40 |
| 28 | ,, - | Riesling - - | ,, ,, | 1·111 | 2·66 | ·70 | 2·63 |
| 29 | ,, | Grenache - - | ,, ,, | 1·100 | 23·6 | ·70 | 2·96 |
| 30 | ,, - | Mataro - - | ,, ,, | 1·101 | 23·9 | ·66 | 2·76 |
| | | | Mean - | 1·111 | 26·6 | ·65 | 2·46 |
| | | | Max. - | 1·158 | 38·6 | ·92 | 3·54 |
| | | | Min. - | 1·083 | 19·1 | ·41 | 1·86 |

## YACKANDANDAH DISTRICT.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15° C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | Hadley Bros. - | Riesling - - | March 30 | 1·092 | 21·5 | ·84 | 3·92 |
| 2 | „ - | Hermitage - - | „ „ | 1·102 | 24·2 | ·71 | 2·93 |
| 3 | Staghorn - | Burgundy - - | „ „ | 1·132 | 32·2 | ·80 | 2·48 |
| 4 | „ - | Muscat - - | „ „ | 1·136 | 33·2 | ·61 | 1·83 |
| 5 | „ - | Verdeilho - - | „ „ | 1·125 | 30·3 | ·71 | 2·34 |
| 6 | „ - | Tokay - - | „ „ | 1·109 | 26·0 | ·60 | 2·31 |
| 7 | „ - | Riesling - - | „ „ | 1·096 | 22·6 | ·70 | 3·10 |
| 8 | „ - | Hermitage - - | „ „ | 1·114 | 27·4 | ·71 | 2·60 |
| 9 | Melville - | Burgundy - - | „ „ | 1·136 | 33·2 | ·70 | 2·17 |
| 10 | „ - | Madeira - - | „ „ | 1·087 | 20·2 | ·51 | 2·52 |
| 11 | „ - | Riesling - - | „ „ | 1·101 | 23·9 | ·65 | 2·71 |
| 12 | „ - | Verdeilho - - | „ „ | 1·126 | 30·6 | ·70 | 2·28 |
| 13 | „ - | Hermitage - - | „ „ | 1·114 | 27·4 | ·65 | 2·37 |
| 14 | „ - | Aucarot - - | „ „ | 1·121 | 29·2 | ·71 | 2·43 |
| 15 | „ - | Muscat - - | „ „ | 1·130 | 31·6 | ·71 | 2·25 |
| 16 | Westmoreland - | Riesling - - | „ „ | 1·105 | 25·0 | ·60 | 2·40 |
| 17 | „ - | Muscat - - | „ „ | 1·123 | 29·8 | ·60 | 2·01 |
| 18 | „ - | Burgundy - - | „ „ | 1·124 | 30·0 | ·65 | 2·17 |
| 19 | „ - | Verdeilho - - | „ „ | 1·126 | 30·6 | ·65 | 2·12 |
| 20 | „ - | Hermitage - - | „ „ | 1·107 | 25·5 | ·60 | 2·34 |
| | | | Mean - | 1·115 | 27·6 | ·67 | 2·42 |
| | | | Max. - | 1·136 | 33·2 | ·84 | 3·92 |
| | | | Min. - | 1·087 | 20·2 | ·51 | 1·83 |

BEECHWORTH.

| Progressive Number. | Name of Vineyard. | Variety of Grape. | Date of Examination. | Specific Gravity, 15°/15°C. | Sugar. Grammes per 100 c.c. | Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c. | Parts of Acid to 100 parts Sugar. |
|---|---|---|---|---|---|---|---|
| 1 | O'Connor's - | Hermitage (6 yrs. old) | March 30 | 1·101 | 23·9 | ·73 | 3·05 |
| 2 | ,, - | Hermitage (26 yrs. old) | ,, ,, | 1·100 | 23·6 | ·70 | 2·96 |
| 3 | ,, - | Verdeilho (6 yrs. old) | ,, ,, | 1·108 | 25·8 | ·92 | 3·56 |
| 4 | ,, - | Verdeilho (26 yrs. old) | ,, ,, | 1·107 | 25·5 | ·88 | 3·45 |
| | | | Mean - | 1·104 | 24·7 | ·80 | 3·24 |

## Table VII.

**Showing the relation between density and degrees Baumé; with the Sugar corresponding in grammes per 100 cubic centimetres of Must, according to Salleron,** *Notice sur les Instruments de précision appliqués à l'Oenologie*, 1887

| Density 15°/15° C. | Degrees Baume. | Grammes of Sugar per 100 c.c. of Must. | Alcohol in Volume. |
|---|---|---|---|
| 1050 | 6·9 | 10·3 | 6·0 |
| 1051 | 7·0 | 10·6 | 6·2 |
| 1052 | 7·1 | 10·8 | 6·3 |
| 1053 | 7·2 | 11·1 | 6·5 |
| 1054 | 7·4 | 11·4 | 6·7 |
| 1055 | 7·5 | 11·6 | 6·8 |
| 1056 | 7·6 | 11·9 | 7·0 |
| 1057 | 7·8 | 12·2 | 7·2 |
| 1058 | 7·9 | 12·4 | 7·3 |
| 1059 | 8·0 | 12·7 | 7·5 |
| 1060 | 8·1 | 13·0 | 7·6 |
| 1061 | 8·3 | 13·2 | 7·8 |
| 1062 | 8·4 | 13·5 | 7·9 |
| 1063 | 8·5 | 13·8 | 8·1 |
| 1064 | 8·6 | 14·0 | 8·2 |
| 1065 | 8.8 | 14·3 | 8·4 |
| 1066 | 8·9 | 14·6 | 8·6 |
| 1067 | 9·0 | 14·8 | 8·7 |
| 1068 | 9·2 | 15·1 | 8·9 |
| 1069 | 9·3 | 15·4 | 9·0 |
| 1070 | 9·4 | 15·6 | 9·2 |
| 1071 | 9·5 | 15·9 | 9·3 |
| 1072 | 9·7 | 16·2 | 9·5 |
| 1073 | 9·8 | 16·4 | 9·6 |
| 1074 | 9·9 | 16·7 | 9·8 |
| 1075 | 10·0 | 17·0 | 10·0 |
| 1076 | 10·2 | 17·2 | 10·1 |
| 1077 | 10·3 | 17·5 | 10·3 |
| 1078 | 10·4 | 17·8 | 10·5 |
| 1079 | 10·5 | 18·0 | 10·6 |
| 1080 | 10·7 | 18·3 | 10·8 |
| 1081 | 10·8 | 18·6 | 10·9 |
| 1082 | 10·9 | 18·8 | 11·0 |
| 1083 | 11·0 | 19·1 | 11·2 |
| 1084 | 11·1 | 19·4 | 11·4 |
| 1085 | 11·3 | 19·6 | 11·5 |
| 1086 | 11·4 | 19·9 | 11·7 |
| 1087 | 11·5 | 20·2 | 11·9 |
| 1088 | 11·6 | 20·4 | 12·0 |
| 1089 | 11·7 | 20·7 | 12·2 |
| 1090 | 11·9 | 21·0 | 12·3 |
| 1091 | 12·0 | 21·2 | 12·5 |
| 1092 | 12·1 | 21·5 | 12·6 |
| 1093 | 12·3 | 21·8 | 12·8 |
| 1094 | 12·4 | 22·0 | 12·9 |
| 1095 | 12·5 | 22·3 | 13·1 |
| 1096 | 12·6 | 22·6 | 13·3 |
| 1097 | 12·7 | 22·8 | 13·4 |
| 1098 | 12·9 | 23·1 | 13·6 |

TABLE VII. *(Continued).*

| Density 15°/15° C. | Degrees Baumé. | Grammes of Sugar per 100 c.c. of Must. | Alcohol in Volume. |
|---|---|---|---|
| 1099 | 13·0 | 23·4 | 13·8 |
| 1100 | 13·1 | 23·6 | 13·9 |
| 1101 | 13·2 | 23·9 | 14·0 |
| 1102 | 13·3 | 24·2 | 14·2 |
| 1103 | 13 5 | 24·4 | 14·3 |
| 1104 | 13·6 | 24·7 | 14 4 |
| 1105 | 13·7 | 25·0 | 14·5 |
| 1106 | 13·8 | 25·2 | 14·6 |
| 1107 | 13·9 | 25·5 | 14·7 |
| 1108 | 14·0 | 25·8 | 14·8 |
| 1109 | 14·2 | 26·0 | 15·0 |
| 1110 | 14·3 | 26·3 | 15·1 |
| 1111 | 14 4 | 26·6 | 15·2 |
| 1112 | 14 5 | 26·8 | 15·3 |
| 1113 | 14·6 | 27·1 | 15·4 |
| 1114 | 14·7 | 27·4 | 15·5 |
| 1115 | 14·8 | 27·6 | 15 6 |
| 1116 | 15·0 | 27·9 | 15·7 |
| 1117 | 15·1 | 28·2 | 15·9 |
| 1118 | 15·2 | 28·4 | |
| 1119 | 15·3 | 28·7 | |
| 1120 | 15 4 | 29·0 | |
| 1121 | 15·5 | 29 2 | |
| 1122 | 15·6 | 29·5 | |
| 1123 | 15·7 | 29·8 | |
| 1124 | 15·9 | 30·0 | |
| 1125 | 16·0 | 30·3 | |
| 1126 | 16·1 | 30·6 | |
| 1127 | 16·2 | 30·8 | |
| 1128 | 16·3 | 31.1 | |
| 1129 | 16 5 | 31·4 | |
| 1130 | 16 6 | 31 6 | |
| 1131 | 16·7 | 31·9 | |
| 1132 | 16 8 | 32·2 | |
| 1133 | 16·9 | 32·4 | |
| 1134 | 17 0 | 42·7 | |
| 1135 | 17·2 | 33·0 | |
| 1136 | 17·3 | 33·2 | |
| 1137 | 17·4 | 33·5 | |
| 1138 | 17 5 | 33·8 | |
| 1139 | 17 6 | 34·0 | |
| 1140 | 17·7 | 34·3 | |
| 1141 | 17·8 | 34·6 | |
| 1142 | 17 9 | 34·8 | |
| 1143 | 18·0 | 35·1 | |
| 1144 | 18 1 | 35·4 | |
| 1145 | 18·2 | 35 6 | |
| 1146 | 18·4 | 35·9 | |
| 1147 | 18·5 | 36·2 | |
| 1148 | 18 6 | 36·4 | |
| 1149 | 18·7 | 36·7 | |
| 1150 | 18·8 | 37·0 | |

## Table VIII.

## DISTRICT MEAN ANNUAL TEMPERATURE AND RAINFALL.

On the authority of R. L. J. Ellery, Esq., C.M.G., F.R.S., Government Astronomer.

| March, 1892, to March, 1893. | | Rainfall for Twelve Months. | Mean Annual Rainfall. | Mean Annual Temperature. |
|---|---|---|---|---|
| Name of Stations. | | Inches. | Inches. | Degrees. |
| Barnawartha District | Retreat Vineyard | 24·39 | 28·02 | 59·3 |
| | Hermitage, The | 20·19 | 22·76 | |
| | Beechworth | 31·88 | 32·40 | 56·9 |
| | Echuca | 17·66 | 18·23 | 59·6 |
| | Lilydale | 35·07 | 36·99 | 57·7 |
| | Nagambie | 23·30 | 28·80 | 58·4 |
| | Rutherglen | 22·00 | 24·64 | 60·0 |
| Yering District | Yering Town | 28·94 | 33·97 | 57·8 |
| | St. Hubert's Vineyard | 31·61 | 30·53 | |
| | Yackandandah | 37·92 | 45·36 | 59·1 |

| March, 1893, to March, 1894. | | Rainfall for Twelve Months. | Mean Annual Rainfall. | | Mean Annual Temperature. |
|---|---|---|---|---|---|
| Name of Stations. | | Inches. | Inches. | No. of Years. | Degrees. |
| Barnawartha District | Retreat Vineyard | 33·90 | 27·47 | 8 | 59.3 |
| | Hermitage, The | 28·87 | 22·78 | 8 | |
| | Beechworth | 46·83 | 32·17 | 22 | 56·1 |
| | Echuca | 19·18 | 18·16 | 15 | 60·3 |
| | Lilydale | 35·21 | 36·25 | 8 | 57·7 |
| | Nagambie | 26·87 | 26·72 | 7 | 58·4 |
| | Rutherglen | 28·55 | 24·70 | 10 | 60·0 |
| Yering District | Yering Town | | 33·55 | 10 | 57·8 |
| | St. Hubert's Vin. | | 31·14 | 3 | |
| | Yackandandah | 48·80 | 42·26 | 7 | 59·1 |
| | Dookie | 27·86 | 22·36 | 14 | 60·6 |
| | Wahgunyah | 26·73 | 22·04 | 21 | 60·3 |
| | Great Western | | 23·73 | 2 | 68·7 |

# Art. VIII.—*Geological Notes on the Country between Strahan and Lake St. Clair, Tasmania.*

(With Map.)

By Graham Officer, B.Sc., Lewis Balfour, B.A., and E. G. Hogg, M.A.

[Read 14th June, 1894.]

The following sketch is the outcome of observations collected during a trip made by the authors in January of this year from Strahan to Lake St. Clair along the overland track.

The first thing of interest, that does not seem to have been recorded as yet, is the occurrence about a mile from Strahan along the track of a deposit which bears a striking similarity to the glacial drift in Victoria. It consists of an unstratified or faintly stratified clay, of great hardness in places, and through which stones and boulders are irregularly scattered. One of these boulders was two feet in diameter, and several bore striæ. In places the clay has a peculiar pinkish-purple colour that is very characteristic of the glacial beds near Bacchus Marsh. As a similar deposit occurs on Mount Tyndall and also on Mount Sedgwick, not very far distant, it is not improbable that the two are identical. We did not observe a direct junction with the Silurian rocks which appear here and occur all the way to the great central plateau.

Mounts Lyell and Owen form part of the West Coast Range, and are at a distance of some thirty miles from Strahan by the track. These two mountains run approximately parallel to each other in an E. and W. direction, being separated by the wide, open Linda Valley. At their westerly extremity they are connected by a narrow saddle, which rises to a height of about 1500 feet above sea level; from this end arises the Linda Creek, which, after being joined by its tributaries, runs due east down the valley for about four miles, when it flows into the King River. Towards its lower end the valley narrows rapidly as the eastern spurs of Mounts Owen and Lyell approach each other.

The Linda Valley has attracted much attention owing to the gold found in its alluvial, and to the other valuable minerals occurring in the ridge bounding it on the west. As might have been expected, in the case of a valley lying between two high mountains composed mainly of the older formations in a highly disturbed region, the geological problems to which it gives rise are very complex.

The lowest rocks exposed consist of schists (principally hydromica), sandstones, quartzites, and conglomerates. These are all inclined at high angles, and have been assigned to Lower Silurian age. Capping and apparently forming the greater mass of Mounts Owen and Lyell is a great series of sandstones and conglomerates. The Linda Valley is to a great extent filled by more recent deposits. The so-called Silurian rocks occur at the upper end of the valley, and may be recognised again at the lower end on the Linda Creek. The ridge joining Mounts Owen and Lyell at the west extremity of the valley is almost, if not entirely, composed of schist. Owing to accumulations of *débris* and the occurrence of thick scrub, and consequent difficulty of observation, it is very hard to determine with anything like precision the geological relationships of the rocks in this country. While certain Lower Silurian fossils have been obtained from rocks in the vicinity, yet, until a careful survey is made, it will be very difficult indeed to assign any given outcrop to a certain age. There are at least two sets of the older rocks with an unconformity between, and it seems quite possible that there may be a third. Thus we should not be surprised if the schists forming the ridge at the head of the Linda Valley turned out to be Cambrian or even Archæan.

Pyrites occurs abundantly through these ancient rocks, and micaceous and specular iron is plentiful; veins of the latter can be seen traversing pink conglomerate, in which the included pebbles are apparently all of quartz and quartzite.

One of the principal features of the western end of the Linda Valley is the now celebrated "Iron-Blow," a mass of hæmatite, and the closely-associated lode (so-called) of pyrites, which is now being worked by the Mount Lyell Company. This mass is apparently interbedded with the country rock, and is inclined at about 63°. The hanging wall is schist, and the footwall conglomerate.

The lode which the Mount Lyell Company are working consists essentially of pyrites. According to Dr. Peters, whose report on the mine was published last year, the great bulk of the ore mass consists of iron and copper pyrites, with a little heavy spar (barium sulphate), and silica, and traces of antimony, arsenic, lead and zinc. This ore also contains about 3 oz. of silver and 2½ dwt. of gold to the ton. Besides this main body of ore, pockets of argentiferous copper pyrites and silver-copper glance occur. This class of ore has proved enormously rich, yielding several thousand ounces of silver to the ton, besides a large percentage of copper.

Several theories have been put forth to account for the formation of the ore, but the most satisfactory is that proposed by Dr. Peters and Mr. Montgomery. According to these gentlemen, the mass of pyrites is an ore-bed contemporaneous with the enclosing country rock, having been probably deposited in a swamp or lagoon of the period. The ore-bed has a thickness of 300 ft. at the surface, this thickness representing, on the above theory, the original depth of the deposit, which may therefore be pretty confidently expected to be of very large extent.

Resting unconformably on the older schistose rocks, with their accompanying sandstones and conglomerates, are massive beds of conglomerate interstratified with sandstones, which are very characteristic of the West Coast Range as a whole. These beds may be traced from the level of the Linda Valley to the summits of both Owen and Lyell. They have in general a south-westerly dip at an inclination of about 40° to 45°; but at the top of Mount Lyell, where they constitute the plateau on which the trigonometrical station was erected, they are dipping to the N.W. at an angle of 15°. They are much jointed, and show a tendency to foliated structure. The included stones, which are almost invariably quartz and quartzites, vary in size from small pebbles to boulders of at least two feet in diameter, thus giving the rock a very striking appearance. The beds are pierced by quartz-veins, which traverse both matrix and included pebble, and the jointing planes, in dividing the rock, also cut right through the quartz pebbles. The foliated structure, which causes the quartz to flake off in thin sections, would appear to show the intense compression to which the beds have been subjected. The matrix

of the conglomerate is a hard, silicious sandstone. The interstratified sandstones, which occur in beds of considerable thickness, vary greatly in character, some being fine, others coarse, and others highly micaceous. A bed of the micaceous sandstone, overlaid by a fine conglomerate, forms the summit of Mount Lyell. From the conglomerate and sandstones lying at the western end of Mount Lyell gold has been obtained in more or less payable quantities. The rocks have in general an appearance of great antiquity, and extending as they do over a large tract of country, their origin, geological age, and the position of the quartzitic highlands of which they are the *dèbris* are questions of great interest. So far as our examination of these beds went, they were unfossiliferous; but certain sandstone boulders containing fossils found on West Mount Lyell, and also on the button-grass plains lying east of the King River, may yet be traced to them. Mr. Moore is of opinion that they should be classified as Devonian. Mr. Montgomery, Government Geologist, in his recent paper on "Glacial Action in Tasmania," states that the Owen conglomerates are conformably interbedded with the quartzites and schists of this district. If he refers to the conglomerates forming the mass of Mount Owen, as we presume he does, our observations lead us to believe that this is erroneous, and that, as we have already stated, there are two sets of conglomerates here—one intercalated with the schists and sandstones, the other—the massive Owen conglomerates—lying unconformably over them.

Among the beds of later origin in the valley is a soft black clay, called by the miners "pug." It attains a considerable depth in places, and rests unconformably on all the older rocks. It is in places stratified, and is said to contain intercalated beds of lignite. It is reported that shells have been found in it, though we were unable to detect any. It contains numerous particles of free pyrites, and would appear, without doubt, to have been formed by the disintegration of the adjacent schistose rocks containing pyrites. Its distribution is confined to the western end of the valley. There is a good outcrop of it just beneath the Iron Blow, and it may be also found at Karlson's Face and at a considerable elevation on the saddle on the Copper Creek. It is probably of lacustrine origin.

Overlying the "pug" is a series of clay, sand, and gravel beds. Two typical sections may be seen on the track to the Queen River, within a short distance from the Iron Blow. The first of these consists of soft irregularly-stratified clay, with bands of grit and larger stones here and there. These rest upon schist, which is much broken and decomposed. It is covered by angular hill-wash. The second, a little further on, shows an unstratified clay containing numerous rounded, angular and sub-angular stones irregularly scattered through the matrix. The stones range from small pebbles up to boulders a foot in diameter. Irregular bands of stratified material, stained with iron, occur here and there. The included stones consist of quartz, quartzites, and hard sandstones, evidently obtained from the adjoining hills. Some of the stones are well striated. On the track between the boarding-house and the Iron Blow occur patches of a dark, tenacious clay, from which well-marked striated stones were procured.

Mr. T. B. Moore, in a recent paper recording the discovery of scored stones from this locality, states that the Linda Valley is covered with a layer of morainal matter. He is also of opinion that "the deep ground hydraulically sluiced" for gold in the upper part of the Linda Valley "is nothing but a huge mass of morainal matter."

Although striated stones undoubtedly occur in the Linda Valley, we must be careful not to ascribe too much to the action of ice, for it must be borne in mind that landslips and other gravitational results may produce, to a greater or less extent, many of the effects noticed in a glaciated area. Further research may bring to light other evidence of glacial action in the shape of *roches moutonnées*, erratics, &c.; and in the absence of such evidence we hestitate in coming to any definite conclusion as to the origin of the striations observed.

The head of the valley, which we should have expected to be somewhat bare and denuded of surface material, had it been occupied by a glacier, within Pleistocene times at least, is filled to a great extent by the pug, clays, gravels, &c., already referred to, besides a great accumulation of angular *débris*, which has gravitated from the adjoining heights. We are inclined to think that much of the morainal matter referred to by Mr. Moore is

simply this gravitated *débris*. Any appearance of *roches moutonnées* is quite absent; on the contrary, whenever any of the bed-rocks appear, they are invariably rough and rugged. The slopes of both Mounts Owen and Lyell are studded with great masses of conglomerate, which have moved down from above, and here and there huge columns of rock, often with smaller blocks perched on their summits, may be seen, and which have evidently weathered into their present state *in situ*.

Lake Beatrice lies some ten miles from the King River Crossing, between Mount Sedgwick and Eldon Peak. It is in the same line of drainage as Lakes Dora, Rolleston, and Spicer, which lie to the north. A stream flows out of the lower end of the lake, which, after a course of two or three miles, joins the King River. This stream is remarkable for the immense size of the boulders in its bed. Not only in the bed of the stream, but on either side, spread over the low-lying ground, do these boulders occur in great profusion. The accumulations show a decided tendency to form ridges. The boulders consist principally of a very hard grit or fine conglomerate, and many of them must be tons in weight. The country here is so densely covered by scrub (beech, sassafras, "horizontal," and bauera) that we found it almost impossible to get any observations of the bed-rock.

The ridge-like form of the boulder accumulations at once suggests a morainic origin. As Messrs. Dunn and Moore showed last year, well-marked evidences of glaciation occur about Lake Dora and the other lakes no great distance away; and Lake Beatrice, as already remarked, is in the same line of drainage: so it would not be surprising if these boulder accumulations really owe their origin to glacial causes. The action of water alone does not seem sufficient to account for their transport, although it is true immense floods must have poured down this valley when the upper parts were occupied by glaciers and almost perpetual snow during the Pleistocene period.

Mr. T. B. Moore states that the King River Valley is covered with morainic matter. Numerous boulders of white sandstone, up to two feet in diameter, many containing masses of brachiopod fossils, are scattered over the valley, being generally concealed by the peaty soil and thick button-grass. Some of this material

may have been originally morainic; but, in the absence of further evidence, it seems to us most probable that it has been distributed to its present position by the King River when flowing at a higher level. On the overland track a cutting occurs, about one-third of a mile from the crossing, which shows a "wash" of water-worn pebbles and boulders that is evidently of fluviatile origin, and which is about fifty or sixty feet above the present level of the stream.

If we are to believe that these boulders have been transported to their present position by the direct action of ice, we will have to admit a much wider glaciation in Tasmania than is generally believed to have taken place, the height of the King River Valley at this place being only 600 or 700 feet above the sea. We may add that other evidence of glaciation in the form of *roches moutonnées* and ground moraines seemed to be quite absent. We noted a large mass of greenstone lying close to the track about a mile from the crossing, and resting on Silurian, which is much decomposed and broken up on the surface. But it would be unwise to infer much from this one instance. There may be a dyke in the vicinity.

From the King River to the Victoria Pass the rocks are of an ordinary Silurian type—slates, shales, and sandstones. Fossils are abundant in places. At a cutting on the track near the King River crinoids were abundant, and trilobites and other forms were common, but we saw no graptolites. Our specimens have unfortunately gone astray.

From Victoria Pass the character of the rocks changes to white quartzites and quartz and talcose schists, while the hills are much barer of vegetation than those further west, a fact probably due to the nature of the rocks, which are, of course, nearly pure silica. At the Collingwood River micaceous sandstones occur, and then from the Franklin River, the white quartzites and schists extend to Mount Arrowsmith. Mount Arrowsmith is just at the edge of the great central plateau of Tasmania, which varies from 2000 to 4000 feet above the sea. Leaving Mount Arrowsmith, the Silurian rocks are also left behind, and one sees instead the massive greenstone crests of Mounts Gell, King William, Rufus, Hugel, and other more or less prominent heights.

At a lower level than the majestic greenstone columns at the summit of Mount King William I. are the almost horizontal beds of the Carboniferous sandstones. The characteristic fossils are very abundant (spirifers, fenestellidæ, &c.). Immediately below the columns, a section clearly shows that this sandstone has been subjected to a severe baking. The rock has been hardened and browned, and much resembles in consistency a well-made brick. In the short time at our disposal we were unable exhaustively to search for fossils ; but, in a few instances, evidences of their former existence in the deposit was established by the presence of a few casts. Instead of showing clearly, as in the section a few hundred yards away, these remnants, too, bore signs of considerable baking, which seems to be additional evidence on the comparative ages of the greenstone and Carboniferous sandstones.

Some discussion has been going on, and differences of opinion have been expressed, on this point. Gould, Strzelecki, and Tenison-Woods considered that the greenstone was post-Carboniferous. Jukes suggested the possibility of its being pre-Carboniferous. Mr. R. M. Johnston maintained the latter view in his "Geology of Tasmania." Professor David, in his presidential address before the A.A.A.S. at Hobart, thought that the greenstone was decidedly of later age than the Carboniferous and Mesozoic rocks. Mr. Graham Officer, in a paper read before the Royal Society of Tasmania last year, produced evidence that the greenstone was post-Carboniferous. Mr. Montgomery's observations also confirm this view. It is only fair to say that Mr. Johnston has modified his views, and now considers, with most other observers, that the greenstone is post-Carboniferous, although he has not yet published this opinion.

The difficulty in deciding this question has always been to obtain the point of contact; a difficulty caused principally by the disintegration and subsequent falling of the greenstone columns, which generally obscure the line of junction. In this section, however, although the actual point of contact is not exposed, the sandstone is observed at a distance of only a few yards from the vertical greenstone columns, and as the former bears unmistakable evidence of having been subjected to a considerable amount of heat, the inference is that the greenstone

has been erupted through the sandstone. The later age of the former may now be considered an ascertained fact.

Lake George, which lies at the foot of Mount King William, has been put down as probably of glacial origin. If this be a fact, further evidence must be adduced to support it. We traversed the steep slopes leading down from the mountain without observing any evidences of former ice action. The horizontally bedded sandstone forms a series of terraces across the gorge leading down to the lake, a form one would hardly expect to see if the rocks had been recently ice-worn. However, there is a large bank or low hill across the lower end of the lake, the appearance of which in the distance certainly suggests a moraine. We were, however, unable to reach it, as the day was far spent.

About eight miles south-west of the southern extremity of Lake St. Clair lies Lake Dixon, a small lake a few acres in extent. The rocks in the immediate neighbourhood present points of considerable geological interest.

The lake is picturesquely situated in a valley about 2000 feet above sea-level, while the eminences within a few miles rise to a height of another 2000 feet.

The Franklin River, here near its source, having flowed through Lake Undine a few miles north, enters Lake Dixon at its northern extremity, emerging again at the southern end.

The neighbourhood of Lake Dixon forms the junction of the east and west drainage areas of Tasmania. The Franklin runs with a general south-westerly direction, afterwards joining the Gordon, which ultimately flows into Macquarie Harbour on the west coast ; while Lake George, at the foot of King William I., about seven or eight miles south of Lake Dixon, and also the Cuvier, a few miles north, drain into the Derwent.

Especially on the western and northern slopes of Lake Dixon are seen numerous outcrops of the Silurian, or possibly older, rocks. They are composed principally of quartzites, quartz-schists, and talcose schists, and are in many places exceedingly hard.

They are all highly inclined, with a general north and south strike. They present wavy, flowing outlines, the exposed smoothed and well-polished surfaces glittering in the sunlight. Individual striæ it is difficult to find, this being probably due to

the nature of the rock, but the general form and surface is typical of *roches moutonnées*—so typical, in fact, as to render a detailed description unnecessary.

In some places recent soil and grass have covered these polished surfaces, but enough is exposed to show that there exists a considerable area of *roches moutonnées*. In other spots, where the surface is quite bare, erratics of various sizes rest immediately on the polished rock.

Of morainic matter there is abundance. The surface of the country round the lower end of the lake, extending for about a mile from the lake, is strewn with rocks of all sizes and shapes and in all positions. Many are large, being some tons in weight, while others are small or of only moderate size. They are composed almost exclusively of greenstone, and it may be mentioned that it is at times difficult, if not impossible, to determine the line of demarcation between the moraines and the shattered columns of greenstone which have gravitated down the valley. Quartzites also occur in the moraine.

Mr. Johnston, in a paper read before the Royal Society of Tasmania last year, remarks that "the romantic . . . valley of Lake Dixon is, *par excellence*, the ideal of a perfect glacier valley. No one, however ignorant of glacial action, could in this neighbourhood gaze upon those beautiful, scooped, or rather abraded, lakes or tarns, . . . the snow-white, polished, billowy, cascade-like *roches moutonnées*, composed of quartzites, on the upper margin of Lake Dixon, together with the tumbled moraines and large erratic on the lower banks—at a level of about 2000 feet—without being impressed with the idea that its singularly characteristic features must have been produced by the slow rasping flow of an ancient river of ice."

In addition to the smoothed rocks, we discovered, clinging to to these surfaces, and principally in the hollows, part of the former ground moraine. This consisted of an intensely hard matrix of clay, in which were embedded and cemented together pebbles and stones of various kinds and sizes, composed of schists, slates, quartzites, greenstone, and other varieties. No attempt at arrangement is discernable, and one distinguishing feature is the occurrence on many of the included stones of scores and striæ. These striations are numerous and well-marked, which,

taken in conjunction with the character and position of the matrix, mark the deposit as a true till or ground moraine.

Lake Dixon, to all appearance, is very shallow. Its edges are not deep, though some of the slopes above are decidedly steep. Reeds grow in the lake for some distance from its northern extremity. It is quite probable that Lake Dixon is a morainic lake.

As to the age of this ice action, it is difficult to say more than that everything tends to show that it has been the work of recent glaciers. The finding of erratics still resting on the polished surfaces is suggestive, while the valley seems to have altered but little since the time when the river of ice slowly made its way downwards.

At first sight it seems strange that we have such direct evidence of glaciation in this valley of the Lakes Undine and Dixon, while the evidence in some of the surrounding valleys is negative. It is of importance, however, to remember that elevation is but one condition essential for the former glaciation in this region. Important elements to be considered are the contour, size, and length of the valley. This valley seems to be admirably adapted, not only for being a gathering-ground of snow, but also for the conversion of this snow into a glacier. Surrounded as it is by mountains rising to a height of 2000 feet above its level—itself 2000 feet above the sea—snow would inevitably collect to some considerable extent, while the slope of the valley would cause sufficient movement in the glacier to enable it to carve and polish and scoop the hard rocks. Added to this, the glacier would be supplemented by tributaries descending from the minor valleys to right and left. At present the snow in winter must be considerable. The last of the previous winter's snow had not melted on Olympus by the end of January, so it is not necessary to assume a very extensive fall of temperature to account for perpetual snow in these regions.

The geology of Lake St. Clair has already been described by Mr. Officer (Trans. Roy. Soc. Tas., 1893). The main features are similar to those about Mount King William, the mountains—*e.g.*, Olympus, Byron, Cuvier, Ida, etc.—consisting of a base of sandstone (Permo-Carboniferous), capped by greenstone. The possibility of its being a glacial lake is worth considering. There

is a great accumulation of greenstone *débris* at its southern end, but it is difficult to say if it is *in situ* or not. The ridge-like form much of this *débris* takes is at least suggestive of moraines.

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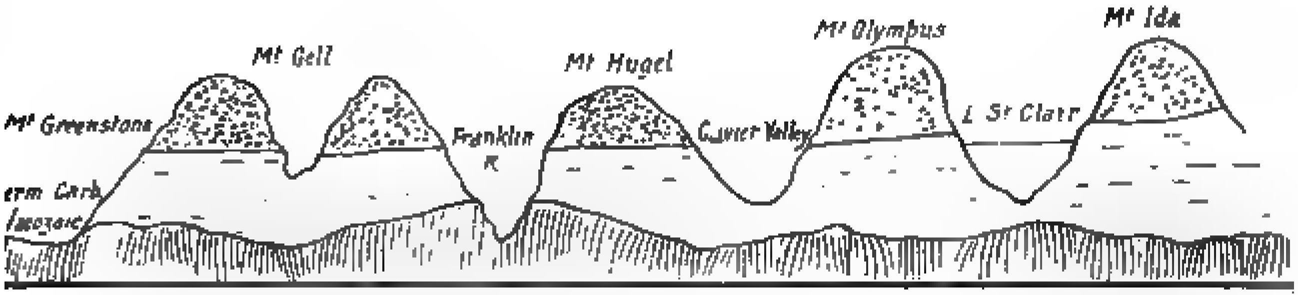
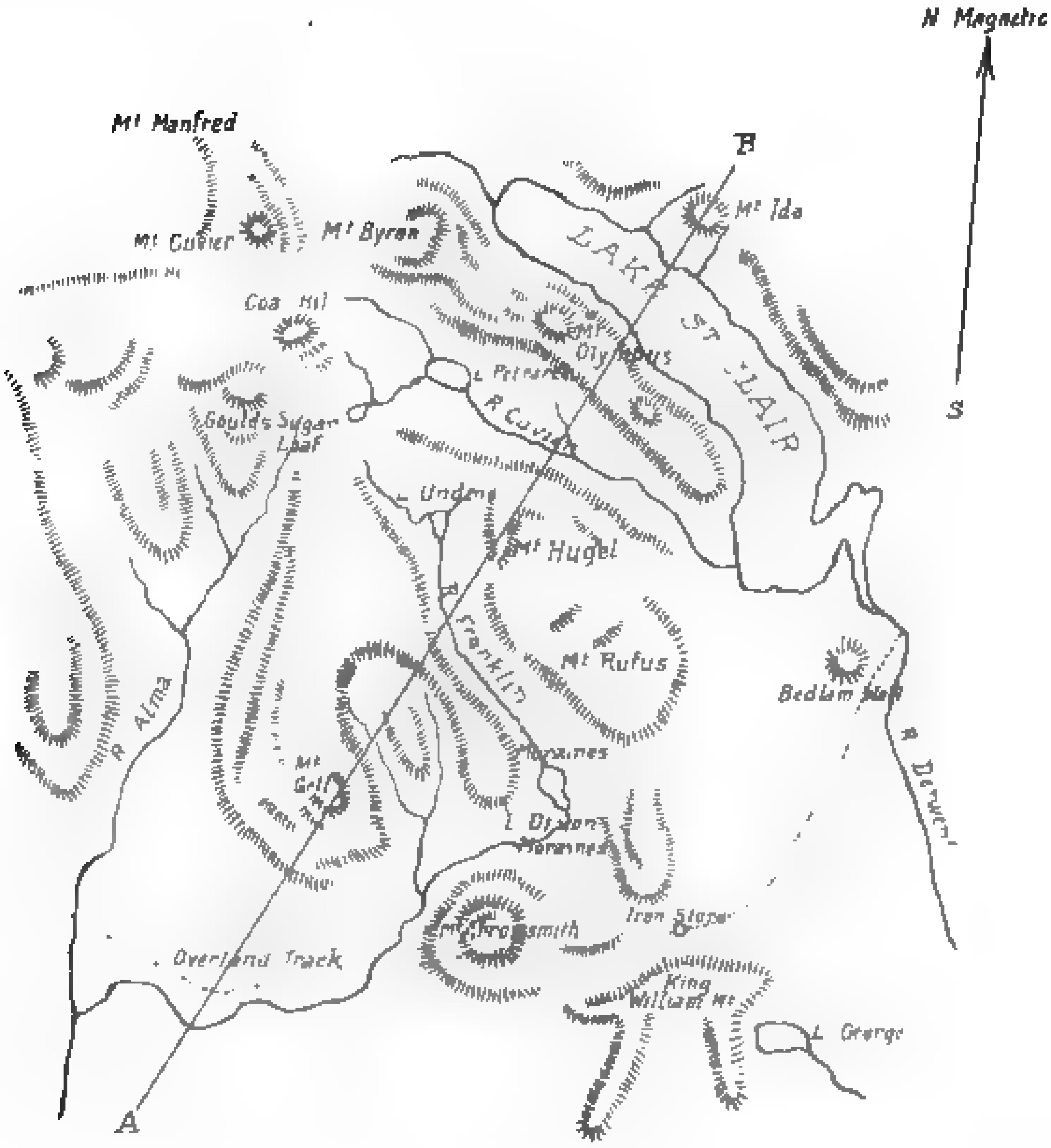



Diagrammatic Section along line A B




Scale
5 Miles to 1 inch

R Wendel lith

## Art. IX.—*On the Australian Species of Amathia.*

By P. H. MacGillivray, M.A., LL.D., M.R.C.S., F.L.S.

[Read 12th July, 1894.]

Several species of Amathia have long been known to occur on the Australian coasts, and were described by Lamouroux and Lamarck. Of late years several others have been added to the list. A great deal of confusion, however, exists as to what these species really are. This has been partly owing to the imperfection of the descriptions, and in some cases to the want of figures.

In the present paper I give descriptions and figures of all those with which I am acquainted, by which I trust that Australian observers will have no difficulty in identifying the species. No doubt others will be discovered, especially from New South Wales, Queensland and Northern Australia, from which my materials are very scanty.

### Amathia, Lamouroux.

### (= Serialaria, Lamarck.)

Class, Polyzoa. Division Ectoprocta. Order Infundibulata. Sub-order Ctenostomata. Family Vesiculariidæ.

*Generic character.*—Zoarium radicate, with free, filiform, usually dichotomous branches, divided by more or less distinct joints or partitions. Zoœcia sub-tubular, occasionally in one, but mostly in two, parallel rows, in continuous series or in distinct groups, which are placed on one, or rarely on two, sides of the branches, or are wound spirally partially or wholly round them.

* Zoœcia forming a continuous or interrupted spiral.

### 1. A. spiralis, Lamouroux.

(Plate A., Fig. 1.)

*Amathia spiralis*, Lamouroux, Hist. des Polypiers Coralligènes Flexibles, p. 161, pl. iv., fig. 2; Expos. Methodique des Genres

de Polypiers, p. 10, pl. 65, figs. 16, 17; MacGillivray in McCoy's Prodromus of Zoology of Victoria, pl. 185, fig. 2.

*Serialaria convoluta*, Lamarck, Anim. Sans Vertebres, ed. 1, ii., 131; ed. 2, ii., 170; ed. 3, i., 212.*

*Serialaria spiralis*, De Blainville, Manuel d'Actinologie, p. 476.

Zoarium forming dense tufts several inches high, attached by fine radical tubes. Branches erect, stiff, dichotomously divided. Zoœcia long, narrow, united laterally through their whole length to form a continuous uniserial spiral, interrupted only at the bifurcations and closely applied to the branch; each zoœcium convex, the contiguous walls of adjoining zoœcia united and projecting upwards as slight points.

Port Philip Heads. Port Jackson, Mr. Whitelegge.

Grows in large tufts, the largest I have seen being nearly five inches high. The branches are long, dichotomously divided, with a length of a quarter to half an inch between the bifurcations. The zoœcia are long, narrow, united side to side to form a continuous spiral closely united or adpressed to the branches which they conceal, and interrupted only at the bifurcations. They are convex, separated by grooves, the united contiguous margins projecting upwards as small points; when dried the anterior surface is collapsed and depressed, the separating walls projecting and their upward prolongations being more prominent.

### 2. A. BICORNIS, Tenison Woods.

(Plate A., Fig. 2.)

*Serialaria spiralis*, Tenison Woods, Proc. Roy. Soc., New South Wales, July, 1877.

*Amathia bicornis*, T. Woods, Proc. Roy. Soc., Victoria, June, 1879; MacGillivary in McCoy's Prod. Zool. Vict., pl. 185, fig. 1.

Zoarium forming dense tufts one or two inches high. Branches irregularly divided. Zoœcia rather long, slightly convex, closely united side to side and arranged in spiral clusters of about two complete turns, the cylindrical stem being unoccupied for nearly

* My copy is ed. 3, Brussels, 1837. It is, I believe, the same as the 2nd edition, edited by Deshayes and Milne Edwards, the extensive additions and new observations on the Polypes being by the latter naturalist. The references to the other editions are taken from Miss Jelly's invaluable Catalogue of Marine Bryozoa.

the same length between the clusters; each zoœcium with a long hollow process on each side, about a half of its length and with a rounded sinus between them.

Port Phillip Heads. Marouba Bay, New South Wales, Mr. Whitelegge.

This is a very marked species, at once distinguished by the separate spiral clusters of zoœcia with the free stem between them, and by the peculiar long, thick, hollow processes from the orifices.

Dr. Pergens, writing without evidently having seen Mr. Woods' proposed name *A. bicornis* (Bull. Soc., Malacol, Belgique, 1887), considers that the name *A. spinosa* attached by Desmarest and Leseur to a figure of this species should be retained. As, however, neither description nor figure was ever published, Mr. Tenison Woods' name must stand.

### 3. A. CONVOLUTA, Lamouroux.

(Plate A., Fig. 3.)

*Amathia convoluta*, Lamouroux, Pol. Corall. Flex., p. 160; De Blainville, Man. d'Actinologie, p. 476.

*Serialaria crispa*, Lamarck, Anim. Sans Vertebres, ed. 1, ii., 131; ed. 2, ii., 172; ed. 3, i., 212.

*Amathia spiralis*, Busk, Challenger Polyzoa, pt. ii., p. 34, pl. vi., fig. 2.

? *A. tortuosa*, Busk, l.c. p. 34, pl. vi., fig. 1.

Zoarium forming tufts of rather loose, long, straggling, irregularly divided branches. Zoœcia long, narrow, arranged in a continuous spiral interrupted at the divisions of the branches, diverging from the axis above and leaving portions of the stem visible between the turns; each zoœcium convex, the contiguous margins not produced into a point.

Port Philip Heads, Mr. J. Bracebridge Wilson.

Forms loose tufts of an olive or brownish colour, the branches two or three inches high and irregularly divided. The zoœcia are long, narrow, closely united laterally except sometimes at the apertures, and forming an open spiral of about one or one and a half turns in each internode, the free margin diverging considerably from the stems, which are conspicuously visible in the

opening of the spiral. The orifices of the zoœcia are not quite so closely united and the adjacent margins are not produced.

No figure was published by Lamouroux or Lamarck, but there can, I think, be no doubt that this is the species intended by them. Lamarck gives Schweiger as an authority for the name *A. convoluta*, but I have not seen his work. It is undoubtedly Busk's *A. spiralis*, and I can see no difference between that and his *A. tortuosa.*

### 4. A. TORTUOSA, Tenison Woods.

(Plate A., Fig. 4.)

*Amathia tortuosa*, Tenison Woods, Proc. Roy. Soc. Victoria, June, 1879; MacGillivray in McCoy's Prod. Zool. Vict., pl. 185, fig. 3.

*Amathia connexa*, Busk, Challenger Polyzoa pt., ii., p. 35, pl. vi., fig. 3.

Zoarium forming long, straggling, irregularly divided, rather slender, cylindrical, transparent branches, several inches high. Zoœcia rather long, in biserial clusters at nearly right angles to the stems and forming an open spiral of one complete turn, occupying greater part of each internode but leaving a small portion inferiorly free.

Port Philip Heads. Port Jackson (Dr. Ramsay).

There can be no doubt that this is the species described and figured by Mr. Woods, and that Busk's *A. tortuosa*, if not identical, as I believe, with *A. convoluta*, is at all events quite distinct from the present.

### 5. A. DISTANS, Busk.

(Plate C., Fig. 3.)

*Amathia distans*, Busk, Challenger Polyzoa, pt. ii., p. 38, pl. vii., fig. 1; MacGillivray, Trans. Roy. Soc. South Australia, June, 1889.

Zoarium forming long, slender, straggling, transparent branches. Zoœcia irregularly biserial, united into clusters forming very open spirals of about one complete turn occupying the upper half of each internode.

South Australia.

I have only a small specimen of this species. It is readily distinguished by the long, very slender, filamentous stems and the spiral cluster of zoœcia occupying the upper half of each internode, the lower part being bare. The zoœcia are rather short, and not very closely united.

** Zoœcia in straight or oblique clusters.

† No appendages.

### 6. A. LENDIGERA, Linnæus sp.

(Plate B., Fig. 1.)

*Amathia lendigera*, Lamouroux, Pol. Corall. Flex., p. 159; Id. Expos. Method, p. 10; Hincks, Brit. Mar. Pol., p. 516, pl. lxxiv., figs. 7-10; Busk, Challenger Pol., pt., ii., p. 33.

*Serialaria lendigera*, Lamarck, An. Sans Vertebres, ed. 1, ii., 130; ed. 2, ii., 169; ed. 3, i., 211; De Blainville, Man. d'Actinologie, p. 476; Johnston, Brit. Zoophytes, ed. 2, p. 368.

Zoarium consisting of dichotomously divided, slender, intricately interwoven branches. Zoœcia in straight, biserial clusters of 4-8 pairs, diminishing in height from the proximal to the distal, and occupying the upper third or half of an internode.

Western Port, Rev. Mr. Porter.

Of this the only Australian specimen I have agrees precisely with the well known European form. It is closely allied to the succeeding, under which the distinguishing characters are pointed out.

### 7. A. OBLIQUA, new species.

(Plate B, Fig. 2.)

Zoarium consisting of slender, dichotomously divided branches, not interwoven. Zoœcia in oblique, biserial clusters of 6-9 in each row, occupying almost the whole length of the straight internodes.

Port Philip Heads.

This is closely allied to *A. lendigera* with which it seems to have been considered identical by Mr. Kirkpatrick. The habit of growth, however, is quite different. It forms tufts of considerable

height, one measuring five inches. It is only attached by the bases of the main stems by radical tubes, the branches being quite free and not intertwining or climbing over other objects. The zoœcial clusters are markedly oblique and extend over nearly the whole length of the internodes, never being restricted to so small a portion as the half. The large size of the zoœcial clusters, and its more regular growth give it a much stouter appearance. In both species the zoœcia are more separated than in the others.

### 8. A. PINNATA, Kirkpatrick.

(Plate C., Fig. 1.)

*Amathia pinnata*, Kirkpatrick, Ann. and Mag. Nat. Hist., July, 1888.

Zoarium pinnately branched. Zoœcia arranged in biserial clusters of 12-16 pairs, occupying greater part of the front of each internode.

Port Philip Heads, Mr. J. Bracebridge Wilson.

The only specimen I have of this very distinct species is that figured. Being the extremity of a growing branch the secondary branches are not so fully formed as in older parts, one on a side being sometimes undeveloped or aborted.

### 9. A. BROGNIARTII, Kirkpatrick.

(Plate B., Fig. 3.)

*Amathia Brogniartii*, Kirkpatrick, Ann. and Mag. Nat. Hist., July, 1888.

Zoarium consisting of dichotomously divided branches. Internodes long, thick and straight, occupied for almost the whole length by a biserial cluster of long, nearly uniform, connate zoœcia.

Port Philip Heads, Mr. J. Bracebridge Wilson.

Distinguished by the great length and straightness of the internodes and the number of the zoœcia from *A. biseriata*, the only species with which it can be confounded. I give Kirkpatrick as the authority for the name, as Desmarest and Leseur, who seem to have indicated it and from whom Mr. Kirkpatrick took

the name, merely had figures prepared, and never published either plates or descriptions.

### 10. A. BISERIATA, Krauss.

(Plate B., Fig. 4.)

*Amathia biseriata*, Krauss, Corallineen und Zoophyten der Sudsee, 1837, p. 23, fig. 1. *A. inarmata*, MacGillivray, Proc. Roy. Soc. Vict., Nov., 1886; Prod. Zool. Vict., pl. 185, fig. 4.

Zoarium forming large tufts of dichotomously divided branches. Internodes of moderate length, slightly arcuate, almost entirely occupied on one side by a biserial cluster of 6-9 pairs of zoœcia, which usually slightly diminish in height from the proximal to the distal extremity.

Port Phillip Heads. Sealers Cove, Baron von Mueller. Westernport.

When I previously described this species as *A. inarmata* I had not seen Krauss' work, and could not procure a copy of it. After seeing his description and figure, I am satisfied that the Australian and South African species are identical. The amount of curvature of the internodes varies, some being almost straight. From *A. Brogniartii*, it differs in the arching and shortness of the internodes, and the small number of zoœcia, and from *A. Woodsii* in the absence of the confervoid filaments, the smaller number and greater thickness of the zoœcia and their not diminishing in size distally in the very marked manner they do in the latter species.

†† With filamentous or confervoid appendages.

### 11. A. CORNUTA, Lamouroux.

(Plate D., Fig. 1.)

*Amathia cornuta*, Lamouroux, Pol. Corall, Flex., 159; pl. iv., fig. 1.

*Amathia Australis*, Tenison Woods, Proc. Roy. Soc. N.S.W., July, 1877.

*Serialaria cornuta*, Lamarck, Anim. Sans. Vertebres, Ed. 1, ii., 131; ed. 2, 131; ed. 3, i., 212.

Zoarium consisting of dichotomously divided branches, incurved and intricately interwoven. Internodes short, straight and occupied for nearly their whole length by a biserial cluster of about five pairs of zoœcia, which gradually increase in length from the proximal to the distal. Two long, hollow, curved processes articulated at the end of each zoœcial cluster.

Port Phillip Heads. Guichen Bay, South Australia, Rev. J. T. Woods. Port Jackson.

This is undoubtedly the *A. cornuta* of Lamaroux, although he only figures a single row of zoœcia; and there is no doubt it is also the species intended by Tenison Woods, but which I wrongly referred in the Zoology of Victoria to that previously described by Goldstein as *A. Woodsii.* It is distinguished by the zoœcia in the clusters increasing slightly in height from the proximal to the distal, and by the peculiar processes from the anterior extremity of the clusters.

### 11. A. Woodsii, Goldstein.

(Plate B., Fig. 5.)

*Amathia Woodsii*, Goldstein, Journ. Microsc. Soct. Vict., 1879.

*A. Australis*, MacGillivrary in McCoy's Prod. Zool. Vict., pl., 185, fig. 5.

Zoarium forming tufts several inches high of dichotomously divided branches. Internodes of moderate length, slightly arched, each occupied for three-fourths of its length by a biserial cluster of 5-7 pairs of zoœcia, diminishing regularly in height from the proximal to the distal; the terminal clusters having beyond the distal zoœcia a pair of large, confervoid and frequently branched processes; and occasionally a similar process replacing a branch at a bifurcation.

Port Phillip Heads. South Australia. Port Jackson. Port Stephen, N.S.W., Baron von Mueller.

At once distinguished by the regularly diminishing clusters of zoœcia and the long branched confervoid processes. One of these processes frequently seems to replace a branch at a bifurcation. They ought possibly to be considered as young or aborted branches.

I regret that I unfortunately overlooked Mr. Goldstein's excellent description and figure when previously describing this species.

### 13. A. Wilsoni, Kirkpatrick.

(Plate D., Fig. 2.)

*Amathia Wilsoni*, Kirkpatrick, Ann. and Mag. Nat. Hist., July, 1888.

Zoarium irregularly branched, of a light brown colour. Main stems having in front a biserial cluster of 6-9 pairs of zoœcia occupying the upper part of each internode; at each joint giving off three branches, two lateral and one smaller posterior; the lateral branches divided into (usually) three internodes; the first two internodes almost entirely occupied by a continuous double row of 7-12 pairs of zoœcia and giving off at the joints two aborted branches; the third internode smaller, with the zoœcia less distinct and terminated by three abortive branches or plumose processes which are thick, glassy, divided into two or three internodes and at each joint give off a short pointed process. The posterior branches from the main stem consisting of a single celliferous internode terminated by three abortive branchlets.

Port Philip Heads, Mr. J. Bracebridge Wilson. Encounter Bay, S.A.

This beautiful species cannot be confounded with any other. The lateral branches turned forwards and arching inwards, with the glassy abortive branchlets, give the whole a very elegant plumose appearance. The zoœcia are of considerable length and closely connate. The abortive branchlets, as in fact are also the main stems and other internodes, are hyaline and subtransparent.

### 14. A. plumosa, MacGillivray.

(Plate C., Fig. 2.)

*Amathia plumosa*, MacGillivray, Proc. Roy. Soc., Victoria, November, 1889.

Zoarium forming large tufts. Primary branches cylindrical, divided regularly by partitions or joints, destitute of zoœcia. Secondary branches given off at the joints in regular diverging

pairs, each pair from an opposite side of the stem to the succeeding, the zoœcia being turned slightly towards the stems; each branch bifurcates, the internode before bifurcation occupied, except at the basal portion, by a biserial cluster of about six pairs of cylindrical zoœcia and each branch of a bifurcation having a similar or smaller group; each of these branches terminating in a pair of confervoid filaments which again divide at their extremities.

Port Philip Heads.

A beautiful species distinguished from all the others by the barren primary stems and the opposite celliferous branches with the confervoid terminating filaments.

## EXPLANATION OF FIGURES.

### Plate A.

Fig. 1.—Amathia spiralis, nat. size. Fig. 1*a*.—Portion magnified.
Fig. 2.—A. bicornis, nat. size. Fig. 2*a*.—Portion magnified.
Fig. 2*b*.—Group of Zoœcia more highly magnified.
Fig. 3.—A. convoluta, nat. size. Fig. 3*a*.—Portion magnified.
Fig. 3*b*.—Another portion of the same.
Fig. 4.—A. tortuosa, nat. size. Fig. 4*a*.—Portion magnified.

### Plate B.

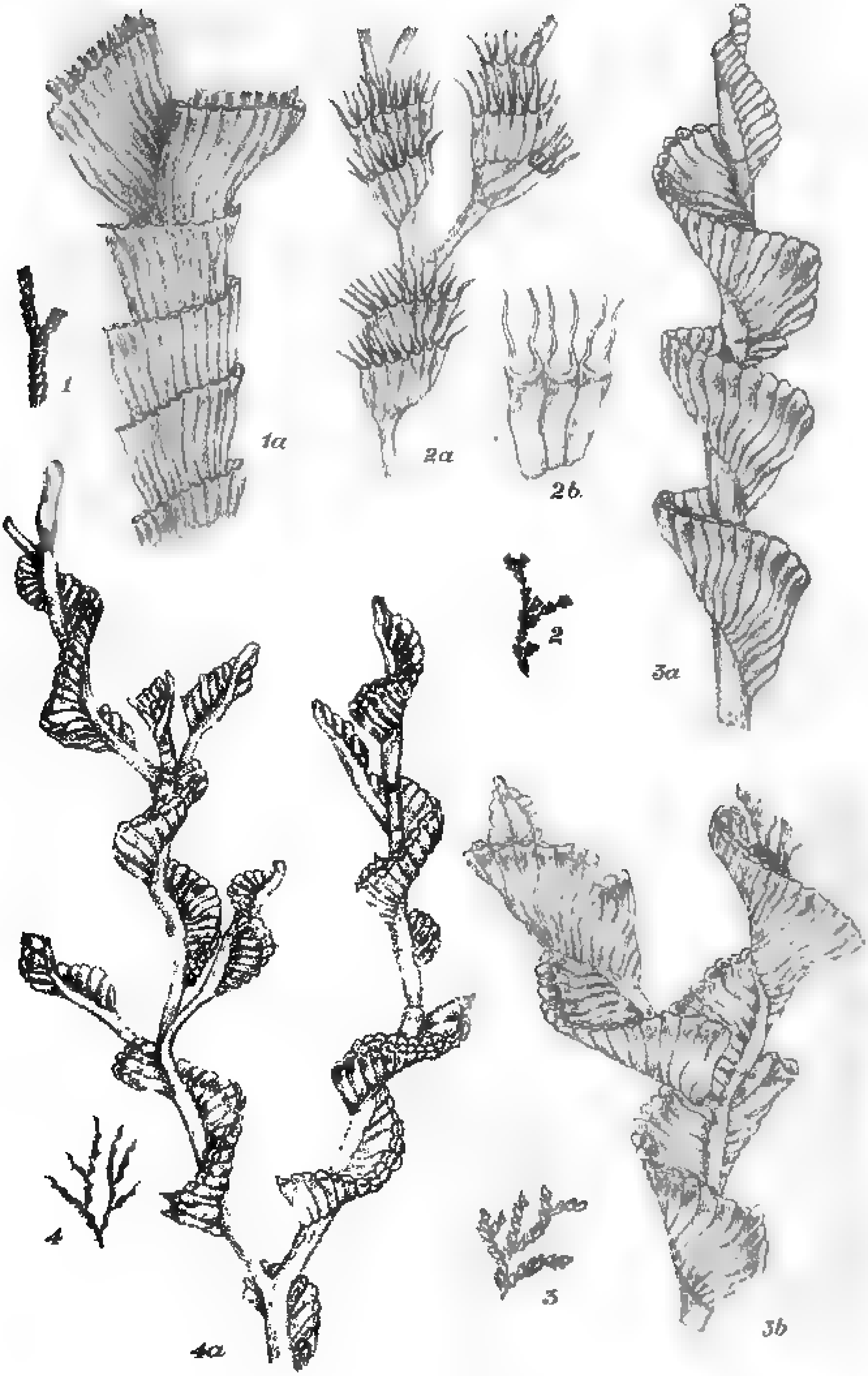
Fig. 1.—A. lendigera, nat. size. Fig. 1*a*.—Portion magnified.
Fig. 2.—A. obliqua, nat. size. Fig 2*a*.—Portion magnified.
Fig. 3.—A. Brogniartii, nat. size. Fig. 3*a*.—Portion magnified.
Fig. 4.—A. biseriata, nat. size. Fig. 4*a*.—Portion magnified.
Fig. 5.—A. Woodsii, nat. size. Fig. 5*a*.—Portion magnified.

### Plate C.

Fig. 1.—A. pinnata, nat. size. Fig. 1*a*.—Portion magnified.
Fig. 2.—A. plumosa, nat. size. Fig. 2*a*.—Portion magnified.
Fig. 3.—A. distans, nat. size. Fig. 3*a*.—Portion magnified.

### Plate D.

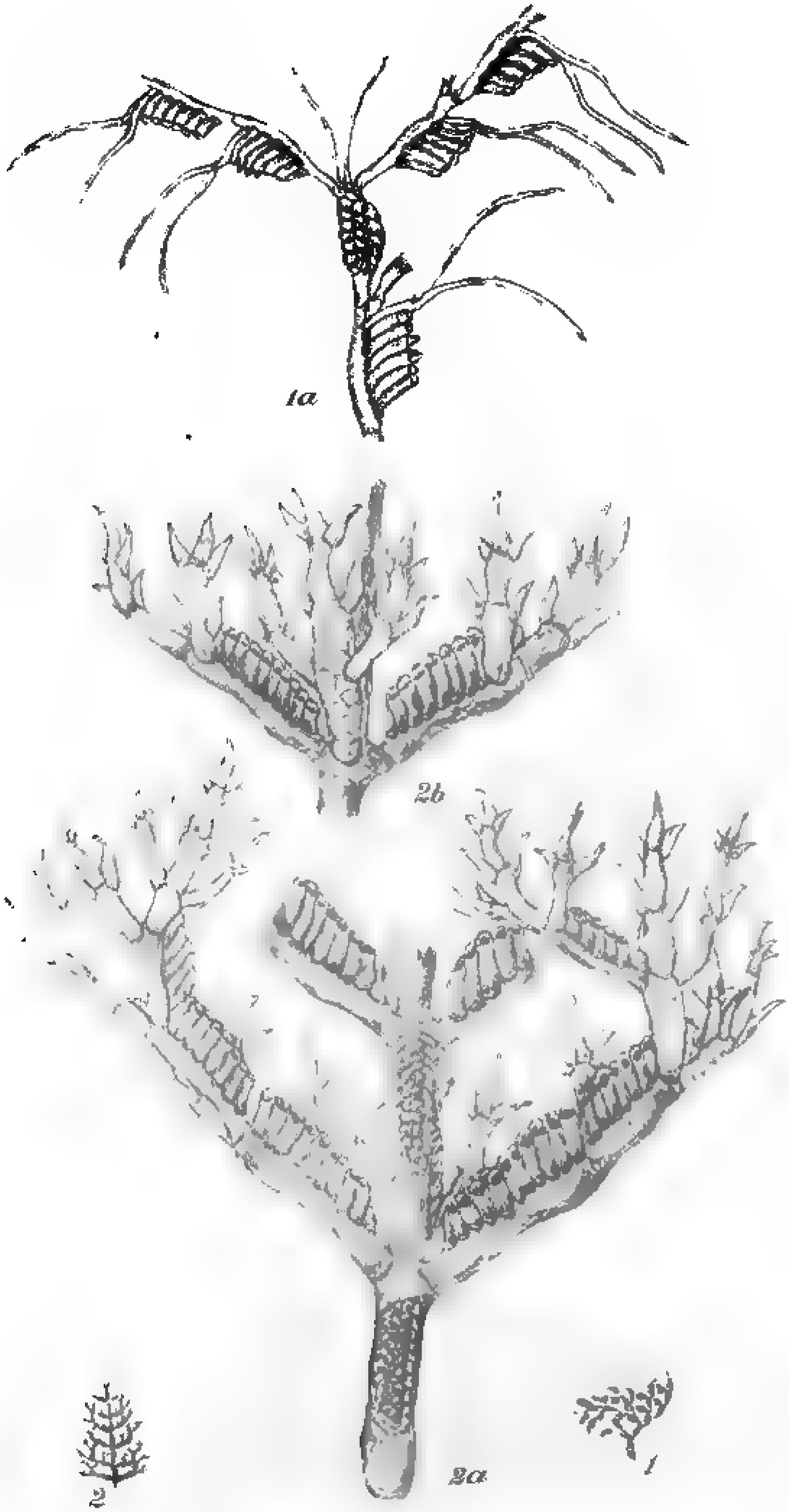
Fig. 1.—A. cornuta, nat. size. Fig. 1*a*.—Portion magnified.
Fig. 2.—A. Wilsoni, nat. size. Fig. 2*a*.—Portion of anterior aspect of branch magnified. Fig. 2*b*.—Portion of posterior surface of same.




160 I

*Plate B.*


1a
1
2
2a
3
3a


1a
2b
2a
2
1

## ART. X.—*On the best Form for a Balance Beam.*

By Professor KERNOT, M.A., C.E.

[Read 12th July, 1894.]

On the 13th May, 1880,* I submitted to this Society a paper on the above subject in which the problem of designing a balance beam of minimum mass for a given strength and rigidity was discussed, and a form was suggested very different from those in general use. This result was arrived at purely by mathematical reasoning. It appeared at the time desirable to verify this reasoning by actual experiment, and models were prepared for the purpose, but the appliances for making the experiments being of a very imperfect kind difficulties arose in making the tests, and the whole matter was laid aside. Recently, however, there has been an opportunity of reopening the question, and with the aid of the large and very perfect testing machine belonging to the Engineering department of the University, a number of experiments have been made which I now propose to describe, and which bear out the conclusions of the paper. Four models were obtained of cast gun metal, and of about the same weight. Two of these represented the form advocated in the paper, while the others represented the type shown by Fig. II. in the diagram (see p. 22, of vol. xvii., Transactions).

The results were as follow, the beams being one foot long :—

| | Load at each end of beam at moment of failure. | Ultimate deflection. |
|---|---|---|
| 1. Design advocated, Fig. 3 of diagram. Weight $12\frac{1}{2}$oz. ... ... | ... 882lbs. ... | ·06 inch. |
| 2. Design advocated, Fig. 3 of diagram. Weight $13\frac{3}{4}$oz. ... ... | ... 1035lbs. ... | ·07 inch. |
| 3. Old form, Fig. 2 of diagram. Weight $12\frac{1}{2}$ oz. | ... 413lbs. ... | .4 inch. |

* Transactions of the Royal Society of Victoria, vol. xvii., p. 19.

| | Load at each end of beam at moment of failure. | Ultimate deflection. |
|---|---|---|
| 4. Old form, Fig. 2 of diagram. Weight $12\frac{1}{2}$ oz. ... | 495lbs. ... | ·5 inch. |

In experiment 4 the beam was placed between boards connected by bolts, in order to check a tendency to bend sideways that had been noticed in experiment 3. This precaution led to a considerable increase of strength, as is shown by comparing the results of experiments of 3 and 4.

As the above beams were not all of exactly the same weight the readiest way of determining their relative merits is by finding how many times its own weight each beam carried. These results, obtained by dividing the load carried by the weight of the beam, are: 1131, 1203, 529 and 634 respectively, showing the enormous superiority of the proposed type.

## Art. XI.—*Aboriginal Rock Paintings and Carvings in New South Wales.*

(With Plates 8 and 9.)

By R. H. Mathews, Licensed Surveyor.

(Communicated by E. F. J. Love, M.A.)

[Read 12th July, 1894.]

For some time I have been studying the rock paintings and carvings made by the aborigines of New South Wales; and last year I prepared a short paper on the subject, and read it before the Royal Society of New South Wales, of which I am a member. My paper appears in the journal of that Society for 1893, Vol. XXVII., pp. 353-358, with three plates. The paper was read in October last, and was fully reported in the newspapers, by which means a great deal of attention was drawn to rock paintings and carvings, and many persons who had never before given any consideration to the subject were thereby induced to collect information, and make drawings of paintings and carvings visited by them, which have been found valuable to our Society here.

It has, therefore, occurred to me that if the subject were brought before the members of your Society, and publicity given to it, it may have the same effect in your colony. With this object in view I have prepared some drawings of aboriginal paintings in caves or rock shelters, and also a few drawings of native carvings on rocks. It is much to be regretted that this subject has received so little attention from early colonists, who could then have easily obtained authentic information in regard to it. These drawings, though primitive enough in design, and rude in execution, yet are highly interesting to the archæologist and ethnologist.

Most, if not all, of the animals painted or carved upon rocks may have been intended to represent the *totems* of the different divisions of the classes forming the community. It is well known that the Australian tribes were divided into classes, which were

again divided into groups bearing the names of animals, as kangaroo, opossum, iguana, emu, black snake, codfish, etc. The figures of animals and other objects, as well as groups of hands, may also have had some symbolical meaning in connection with the myths and superstitions of the Australian aborigines, or were drawn with the object of conveying some kind of knowledge. These points require further investigation before any conclusion of a definite character can be arrived at.

I will first describe the rock paintings, and the method of producing them, and will then deal in a similar manner with the rock carvings.

## Rock Paintings.

Many of the cave paintings of New South Wales consist of representations of the human hand, and these are done in two different ways—one of which has been called the *stencil* method, and the other the *impression* method. The former is the most generally adopted for hand pictures, and is likewise used in many instances in representing implements of the chase.

In *stencilling* figures of the human hand or other objects on the walls and roofs of caves or rock shelters, a smooth surface was selected and slightly wetted or damped with water. The palm of the hand was then placed firmly on the surface of the rock, with the fingers and thumb spread out, and the required colour squirted or blown over it out of the mouth. Probably one native would hold his hand on the rock, and another would apply the colour; but it was quite possible for one operator to do both. Sometimes the part of the hand which was laid on the rock was slightly greased with animal fat to make it fit closely against the stone, and thus prevent the colouring matter getting under it. For the white colours they used pipe-clay, and for the red, red oxide of iron, commonly known as red ochre. I got this information from Mr. John Medhurst, who is now an old man. About the year 1843 or 1844 he was living on Wollombi Creek with his father, and saw the blacks stencilling their hands on the wall of a rock shelter. I asked him if the coloured clay was wetted before being put into the mouth, but he said it was not,—the dampness of the rock makes it adhere, and firmly attach itself to the stone, where it appears to have the durability of an

ordinary pigment. On removing the hand, the space it occupied has the natural colour of the rock, whilst around its margin is smeared with the colour used by the operator. If the object to be drawn be a boomerang, a tomahawk, a waddy, etc., the same course is followed, if this method of producing it be adopted. All the objects shown in Figs. 3 and 4 are drawn in this style, as well as some of those appearing in Figs. 2, 5 and 6, Plate 8.

In the *impression* method before mentioned, the colour to be used was mixed with water, or with bird or fish oil, in a hollow piece of bark, or in a stone with a depression in it, into which the hand was dipped, and then pressed firmly against the surface of the rock, when the impression of the hand was left very clearly. In Fig. 2, the rows of twenty-seven and thirteen hands are done in this way, the remaining seven being stencilled. I have never seen or heard of any figures except the hand having been executed in this method. Mr. W. E. Armit, a writer in Curr's *Australian Race*, Vol. II., p. 301, says—"I have often myself seen the blacks on the Leichhardt River, Queensland, imprint their hands, stained with red ochre, on rocks and trees, and I cannot accept such marks as a proof of antiquity."

In the districts visited by me in collecting information on this subject, I have found impressed hands in comparatively few caves, the stencil method being that generally adopted. Perhaps the work was more easily done in the latter style—there being no necessity for preparing and mixing the colour; or, it may be that impressed hands had some particular meaning.

Native pictures of men, animals, and other objects, to which neither of the preceding methods would be applicable, are drawn in *outline* in various colours. In these cases the colours used are mixed with bird or fish oil, or the fat of some animal; pipe-clay and red ochre being used for white and red, respectively; and where black was required, it was made from ground charcoal, or soot, similarly mixed with grease. Mixing the colours with an oily or fatty substance caused them to penetrate the surface of the rock, and become very durable. In some cases the figures were merely outlined, as in Fig. 6, in others as in Fig. 1, they were shown in solid colour all over; whilst in others the space within the margin of the outlines was shaded by strokes of

the same, or a different colour. See Plate XIX., *Jour. Roy. Soc. N.S.W.*, Vol. XXVII.

I have visited between fifty and sixty rock shelters containing native drawings, and only in a few of them have I found yellow colour employed, and then only for some small figures. The reason for this is that yellow clays are not plentiful. Blue colour is still scarcer, and I have only observed its use in one cave.

Vegetable colours were also known to the aborigines. E. Stephens says they painted red bands on their shields by means of the juice of a small tuber, which grew in abundance in the bush.—*Jour. Roy. Soc. N.S.W.*, XXIII., p. 487. The apple tree, and also the grass tree, of Australia, yield a red gum or resin, which has the property of staining anything a red colour.

## Rock Carvings.

Whilst I was engaged in visiting a group of native carvings on a tributary of Broken Bay, I came upon some which had been partially carried out and then abandoned, which disclosed to me the method the native artist employed in producing the work. A number of holes were first made close together along the outline of the figure to be drawn, and these were afterwards connected by cutting out the intervening spaces, thus making a continuous groove. It is probable that the object was first outlined by drawing a piece of coloured stone or hard pebble along the line to be cut out. Judging by the punctured indentations made in the rock in cutting out the lines of these figures, I conclude that the natives used a hard pebble ground to a point, and used as a chisel. As soon as the outline of the figure was chiselled out to the required depth, I think the remainder of the work was done with a stone tomahawk. I am led to this conclusion because the sides of the groove are cut more evenly than could have been done with such an instrument as the holes were punctured with; and there is no doubt the work could thus be done with greater expedition. From the smoothness of the edges of these grooves in a few of the best executed figures, I am inclined to believe that, after the chopping out was finished, the edges were ground down by rubbing a stone along them. In

support of these conclusions I may state that close to the figure shown in Plate IX., Fig. 7, I found a sandstone rock which had been used by the aborigines for grinding their stone weapons. I observed places hollowed out by sharpening tomahawks, and near them were much narrower hollows in which it was evident some pointed instrument had been ground. I saw the same thing on a rock close by where the figure shown in Fig. 8 is depicted. The carvings of men and other objects are generally found on horizontal surfaces of sandstone rocks, which are numerous for many miles around Sydney; but are sometimes seen on the walls of rocks occupying a perpendicular position.

As regards the age of these drawings, some wild and fanciful hypotheses have been propounded by some writers, but from the facts set forth in this paper it must be conceded that the practice of painting rocks was in vogue among the aborigines at the time the white people first settled in New South Wales.

With respect to the rock carvings, so far as I am aware at present, they have not been observed by any European in course of production, but, nevertheless, I am not inclined to attach any great antiquity to them. As far as I have been able to learn, these carvings have not been observed in any other part of New South Wales, except within a radius of about fifty miles from Sydney. This point is not, however, definitely settled. I am making enquiries through correspondents in different parts of the colony, with a view of ascertaining if the practice has been observed elsewhere.

Mr. Ernest Favenc, who has travelled a great deal in Western Australia, informs me that, in the Murchison District of that colony, he found gigantic representations of a human foot, and and other marks, scratched upon granite rocks by the aborigines. These scratchings were not deep, owing to the extreme hardness of the stone, and appeared to have been worn out by repeated rubbing, probably with a very hard pebble, along the outlines drawn on the rock. All the figures of feet seen by Mr. Favenc had six toes.

Mr. W. Y. L. Brown, Government Geologist, Adelaide, states that he has seen at Paratoo and Oulnina, South Australia, representations of the feet of kangaroos delineated in outline on the surface of the rocks by some sharp instrument; and at

Blanchewater, also in South Australia, he saw similar outlines of human feet, in addition to those of the kangaroo.

Mr. Arthur J. Giles, in 1873, discovered at the junction of Sullivan's Creek with the Finke River, South Australia, carvings cut from a quarter to half an inch deep into the face of a cliff of hard metamorphic slate. The carvings consisted of perpendicular grooves, about an inch and a half wide, besides other minor devices.

Mr. Henry Tryon describes, what he calls, some "rock engravings" on Pigeon Creek, on the bridle path from Tenthill to Pilton, Queensland. In an outcrop of sandstone there is a cave or rock-shelter, on the walls of which figures are cut, in some cases to the depth of an inch; whilst some are merely scored on the rock.—*Proc. Roy. Soc. Q.*, Vol. I., pp. 45-52, plates xi. to xiii.

It will thus be seen that carvings of a rude and elementary character have been observed in Western Australia, South Australia and Queensland, whilst in the district around Sydney, New South Wales, they are better executed, and are on a more extensive scale. This would seem to indicate that the natives of the eastern coast had perhaps been influenced by a higher race, such as the Malay or a kindred people.

If any of the members of your Society, who hear this paper read, or who may see the report of it in your Journal, know of any rock paintings or rock carvings in Victoria, or elsewhere, I would ask them, in the interests of science, to collect all the facts they can, and either bring the matter before your Society, or communicate with me.

## Descriptions.

I will now proceed with the descriptions of the figures shown in Plates VIII. and IX., annexed to this paper:—

*Plate VIII.*, Fig. 1.—The cave or rock-shelter containing these drawings is situated in an escarpment of Hawkesbury sandstone, about 5 chains north from portion No. 33, of 40 acres, in the Parish of Wareng, County of Hunter. The length of the cave is 16 feet; height, 6 feet 6 inches; and the depth from the entrance to the back wall, 11 feet 6 inches. The front of the shelter faces S. 20° W.

The paintings, which are all drawn in solid black, consist of two human figures, the tallest one measuring 2 feet 3 inches from the feet to the hands; the smaller one measuring 1 foot 9 inches, and having appendages on the ears or sides of the head resembling those seen in Fig. 7. The other figures are a kangaroo jumping; a dog; two birds; two figures, which appear to be intended for eels; a boomerang; what appears to be designed to indicate the track of an emu; and near the tail of the kangaroo is a figure which appears to be intended for a bird, or flying squirrel, on the wing.

*Plate VIII.*, Fig. 2.—This shelter is 28 feet long, 18 feet high, 11 feet from front to back, and faces north-east. It is on the end of a rocky point reaching into a sharp bend in Cox's Creek, about 2 chains from the eastern boundary of Portion No. 65, of 40 acres, in the Parish of Coolcalwin, County of Phillip. All the drawings are in red colour.

The total number of hands delineated in this shelter is 96, besides other objects, but I have only shown 40 impressed hands and 7 stencilled ones; of the former there are two, and of the latter four, left hands. There are two waddies represented; one of which, four feet long, being stencilled; and the other, 3 feet 7 inches long, drawn. A circular figure, 3 feet by 2 feet 9 inches, with a line leading from it to the stencilled waddy, completes the paintings shown on this Fig.

*Plate VIII.*, Fig. 3.—This cave or rock shelter is situated in an escarpment of Hawkesbury sandstone within Portion No. 81, of 108 acres, in the Parish of Bulga, County of Hunter, and faces N. 20° W. Its length is 54 feet, depth from the front inwards 11 feet, and its height varies from 6 feet 6 inches to 4 feet 6 inches, the floor being irregular.

This Fig. shows seven representations of waddies, two tomahawks, two boomerangs, eight hands, and a figure which appears to be intended for the head of a tomahawk without the handle. Two out of the eight are right hands. All the figures are stencilled in white on the natural surface of the sandstone. This cave contains twenty-six hands altogether, besides other objects, but I have given the most interesting group in this Fig.

*Plate VIII.*, Fig. 4.—This small cave is in a sandstone rock facing N. 25° E., a short distance from the southern shore of Red Hand Bay, a tributary of Middle Harbour, near Sydney.

Its length is 6 feet, depth inwards 3 feet 9 inches, and height 3 feet 4 inches.

The paintings consist of six right hands, two of them being children's; three left hands; and three right feet, two of which are those of children. All these figures are done in white stencilling. It may be stated that representations of feet are uncommon, and are only met with occasionally.

*Plate VIII.*, Fig. 5.—This large rock shelter is situated in an escarpment of sandstone rock, about three-quarters of a mile southerly from Portion No. 4, of 40 acres, in the Parish of Wilpinjong, County of Phillip. Its length is 79 feet, 25 feet deep from the front inwards, 6 feet 6 inches high where the roof meets the back wall, and increases in height outwards towards the front. The cave faces the north-east.

The drawings in this large cave are very numerous and comprise various objects, but the Fig. shows one of the most interesting groups, which is on the roof of the cave. On the left are an iguana and a snake, each about 3 feet 3 inches long with their heads in opposite directions. Above these are two drawings which appear to have been intended to represent the sun, one having eighteen rays and the other thirteen. The larger is eighteen inches in diameter, and the smaller one foot. On the right hand side of the Fig. is a circular object, six inches in diameter, which may have been drawn to indicate the moon. On the right of this figure are three crosses, which suggest the supposition that they were intended for stars. "The Bushmen of the Kalahari Desert in South Africa decorate the walls of their dwellings with the representations of quadrupeds, tortoises, lizards, snakes, fights, hunts, and the different heavenly bodies. The drawings made inside caves are chiefly upon sandstone in ochres of various colours."—*Anth. Jour.*,* X., 460. Extending from the circular object towards the snake are fifteen tracks in red, of a bird's foot, to another small cross. At the commencement of these tracks, and above them, are three similar tracks drawn in white colour, as if to distinguish them from the others. A short distance below all the foregoing figures are fourteen

* Throughout this paper I have used this contraction for the "Journal of the Anthropological Institute of Great Britain and Ireland."

stencilled hands, the right and left being equally represented. Four of these are the hands of children, and two show the hand in the shut position, which is very uncommon. All the figures shown on this Fig. are drawn in red colour, except the three tracks of a bird above referred to.

*Plate VIII.*, Fig. 6.—This cave or rock shelter is 44 feet long, 23 feet deep inwards from the front, and varies from 5 feet to 8 feet high, owing to inequalities of the roof; and faces S.50° E. It is about 8 chains westerly from the western boundary of Portion No. 42, of 120 acres, in the Parish of Tollagong, County of Hunter. It occupies the base of a mural precipice, having been worn out by fluviatile action and atmospheric influences. The roof is begrimed with the smoke of numerous fires, and the shelter appears to have been used as a camping place by the aborigines for many generations.

The drawings in this cave are numerous, and of great interest, but the Fig. shows only one of the groups. The first object on the left of this Fig. appears to be intended for a native bear; then follow the figures of four iguanas, the largest of them being 3 feet 6 inches long; and lastly three stencilled representations of the left hand. All these drawings are in white.

Another group of drawings in this cave comprises two blackfellows and their gins, there being an interval of about 5 feet between each couple. The male figures are considerably the larger in each instance. This group has been included in a paper which I am preparing to read before the Royal Society of New South Wales, on an early date.

*Plate IX.*, Fig. 7.—This gigantic figure of a man is carved on a flat rock of Hawkesbury sandstone on the top of a high range, overlooking Cowan Creek, a tributary of the Hawkesbury River, and is about a chain and three-quarters from Tabor Trigonometrical Station. The height from the feet to the top of the head is 9 feet 8 inches, and the width across the body 3 feet 9 inches. There is a forehead band in which some ornaments are stuck, or they are attached to the ears. "In some tribes feathers of the owl and the emu were fastened to the forehead and ears."—*Anth. Jour.*, XX., p. 85. In the right hand is a club, 2 feet 6 inches long, with another, 2 feet long, lying close by; in the left hand is a shield, 3 feet 8 inches long, and 1 foot 8 inches across the

middle. The eyes, nose and mouth are shown—the latter rather to one side. In the belt, around the waist, some object appears to be carried, resembling the end of a boomerang, although the part below the belt is not shown. It is well known that boomerangs were sometimes so carried.—*Aborigines of Victoria*, I., p. 132 and p. 277. One of the feet has six toes, and the other only four. Within the outline of the man is a subordinate carving which I am unable to identify. This figure appears to have been designed to represent an aboriginal warrior, with his clubs, shield, and boomerang, having his head decorated in the usual manner. After the ceremony of the *Bora* the young men were "invested with the belt of manhood . . . the forehead band . . . and the full male dress."—*Anth. Jour.*, XIV., p. 311. In Collins' *Account of the English Colony of N.S. Wales*, pp. 365-374, he states that at the conclusion of a *Bora*, which he witnessed, each young man had "a girdle tied round his waist, in which was stuck a wooden sword; a ligature was put round his head, in which was placed slips of grass-tree, which had a curious effect." In Henderson's *Observations on the Colonies of N.S. W. and V.D.L.*, pp. 145-148, it is said that after a young man had passed through the ceremonies of the *Bora*, "he was permitted to wear a girdle, and to carry the spear and other war arms, like men."

My comparison of the dress of this chief to the dress worn by the blacks who have been initiated is merely to show the sort of dress worn by the men on ceremonial occasions. I do not mean that this figure represents a man who has just been initiated,—or that it necessarily has anything to do with the *Bora*.

All the lines on this Fig. are cut into the rock in the manner described at page 146 of this Paper, and are about half an inch deep, and an inch and a quarter wide, and are well finished.

*Plate IX.*, Fig 8.—This group of carvings is on a flat sandstone rock on the western side of the track from Pymble to Cowan Creek, a tributary of the Hawkesbury River, about half a mile southerly from Bobbin Trigonometrical Station.

The carving represents a man and woman in the attitude assumed by the natives in dancing a corroboree. The eyes and mouth are delineated, but the nose is missing in both. Each has the belt round the waist, and the male figure has a band around the arms near the shoulder. See *Anth. Jour.*, XIV., p. 311. The

male figure is very much the largest, and this disparity in the sizes of men and women is found in all the paintings, as well as carvings, which have come under my notice. Seventeen ray-like lines rise from the head of the man—and eight from the head of the woman—which may either be intended for hair, or ornaments stuck in it. To the left of these figures is a carving evidently intended to represent a native bag, but it is drawn out of proportion to the human figures. The remainder of the group consists of four large rudely carved representations of feet.

*Plate IX.*, Fig. 9.—This Fig. shows two representations of figures of iguanas or crocodiles. One is carved on a flat rock on Portion No. 1140, of 40 acres, in the Parish of Manly Cove, County of Cumberland. It is 6 feet 7 inches long, and 9½ inches across the widest part of the body; the legs have no claws upon them, and the head is bent as if the animal were looking about. Round the body are three bands similar to those found on the bodies of men and women, which would lead us to suppose that this animal was reverenced by the natives or their forefathers, and would perhaps suggest a Sumatran origin of the tribes who executed these drawings. These bands may have been intended to indicate the stripes seen on the bodies of iguanas. The other is carved on a flat sandstone rock not far from the group shown in Fig. 8, and is 7 feet 2 inches long, and 13½ inches across the body. An eye is shown, and the claws are not forgotten.

*Plate IX.*, Fig. 10.—This carving is situated on Portion No. 1139, of 24½ acres, Parish of Manly Cove, County of Cumberland. The larger figure of this group does not resemble any known animal, and appears to represent some monster of the native artist's fancy. A human figure appears on the body of this animal which is, in my opinion, a separate picture drawn there before or after the other one, owing to the suitability of the surface; the same may be said of the object below the left foot of the human figure. It is not uncommon to find small carvings within the outlines of larger figures in this way.

*Plate IX.*, Fig. 11.—This Fig., which is on the same rocks as Fig. 10, shows the outline of a young female, 3 feet 7 inches

high. The drawings of full-grown women always have the teats delineated, whether in paintings or carvings.

*Plate IX.*, Fig. 12 is on the same rock as Fig. 10 and 11, and, I think there can be no doubt that it represents the native dog. It is three feet six inches long, and stands about 1 foot 8 inches high.

*Plate IX.*, Fig. 13 is an average specimen of the kangaroos carved on rocks, both as regards size and style of work. This figure is on a large flat rock sloping slightly northerly, near the southern boundary of Portion No. 717, Parish of Manly Cove, County of Cumberland.

*Plate IX.*, Fig. 14.—This group is on a flat rock about twenty-eight yards south-westerly from Fig. 8. It includes an emu about seven feet nine inches from the point of its bill to the end of its tail, and about five feet three inches high. Only one leg is drawn, and the foot is a straight continuation of the leg, a mode of drawing I have before found in native figures of emus. There are two human figures, with their heads in contrary directions; they both have belts round the waist and bands round their ankles. The latter are unusual, and have not been seen by me in other carvings. Sir George Grey, in his *Two Expeditions in N.W. and W. Australia*, II., p. 250, says that strings made of the fur of the opossum were tied like bracelets round the wrists and ankles. The feet of the smaller figure are turned inwards, which is the only case where I have observed this —the toes usually pointing outwards, as in the other figures shown on the Plate; a representation of hair is also shown on the head, as in Fig. 8. The larger figure has what appears to be intended for a spear or club in his hand, only a small part of the weapon being shown. It will be observed that the line which forms the head of the larger human figure, also serves to mark out the tail of the emu. There is an oval-shaped hollow in the rock (see Fig.) which was, I think, naturally there, in which water lies during the winter, and after rain in the summer, so that if the lines of the figures were originally continued through this hollow, they have long since wasted away. I have shown by dotted lines where it is probable grooves formerly existed.

*Plate IX.*, Fig. 15.—This carving of a gigantic fish is found upon a large flat sandstone rock, on Portion, No. 83, of 320 acres,

in the Parish of Narrabeen, County of Cumberland. It is 42 feet 6 inches long, and upwards of 12 feet across the widest part of the body, not including the fins. The mouth is open, the upper jaw being 2 feet 7 inches long, and the lower 2 feet. Both eyes are shown on the same side of the head—a common practice among the blacks when drawing representations of fish. This fish has a pectoral, a ventral, and two dorsal fins. Sir Charles Nicholson describes a carving of a large fish at Middle Head, Port Jackson, which was "upwards of 30 feet long."—*Anth. Jour.*, IX., p. 31. In the *Records of the Geological Survey of N.S.W.*, Vol. II., p. 178, Mr. Etheridge describes a large fish 31 feet 9 inches long, carved on a flat rock, near Manly, not far from Sydney. The carving which I have shown in Fig. 15, is, therefore, 10 feet 9 inches longer than any drawing of a fish hitherto recorded.

It is not improbable that this large fish was intended for the porpoise, which was venerated all along the eastern coast from Gippsland to Newcastle. It was a common practice with the aborigines to draw on a large scale any animal they wished to honour. On one of their *Bora* grounds I found a horizontal figure of Baiamai, 20 feet long, formed of raised earth on the surface of the ground.

## General.

All the figures shown on the plates are drawn to scale, and are accurately reproduced from measurements taken by me with a tape measure in every instance; the directions which the shelters face were taken with a pocket compass. The position of each painting and carving on the Government maps is also given, so that they can be found by anyone wishing to see them.

In the newspaper report of the expedition fitted out by Mr. W. A. Horn, for the scientific exploration of the McDonnell Ranges in Central Australia, it has amongst its objects—"the reproduction by photography of aboriginal paintings in caves and on rocks."

Rock paintings by the aborigines have been observed from the time of the earliest explorers, and are universally distributed over Australia, having been noticed in all the colonies at places far apart, but there has, hitherto, been very little attention paid to them. These paintings have frequently been seen in different

parts of Western Australia, South Australia, Queensland, and New South Wales, but are not well known in Victoria. Mr. Curr, in his work on *The Australian Race*, vol. i., p. 96, states "In the Victorian Valley, Victoria, there is, I have often heard, a cavern, the roof of which is covered with old aboriginal paintings. The roof is said to be several feet from the ground, and out of reach." Caves whose painted roofs are at present out of reach are not uncommon, and have been met with by me,—the reason of this is that the floors have been wasted away by the action of the weather.

From enquiries I have myself made, I learn that there are caves containing aboriginal *paintings* on the western side of the Victoria Range, County of Dundas; and also on the north-eastern side of the Grampians, County of Borung. The railway runs within easy distances of both these localities, so that any gentlemen capable of copying these cave paintings could easily visit the districts in which they are to be found. I have, no doubt, that upon arriving in that part of the country, numbers of similar caves would be heard of by making enquiries from old residents. I hope someone will take sufficient interest in this matter to go into the districts indicated, and that his visit will result in the preparation of a paper on the subject to be read before your Society. Anyone going into that part of the country ought also to enquire if any aboriginal *carvings*, similar in character to those described in this paper, have ever been observed upon the surfaces of sandstone rocks. As far as I have been able to learn, none of these rock carvings have hitherto been observed in any part of Victoria; but I can see no reason why they should not be found there, and ought, therefore, to be searched for. Localities abounding in large flat masses of sandstone rocks, with smooth surfaces, are the likeliest places to find these carvings.

Enquiries ought to be made in different parts of Victoria, besides those I have mentioned, in the hope of hearing of other cave paintings.

I have contributed this paper on the Rock Paintings and Carvings of New South Wales, in the hope of adding to the scanty literature of a subject which is one of those having very great interest to the anthropologist, as well as to the historical and classical student.

THE Author desires to make the following additions and correction to the article on "Aboriginal Rock Paintings and Carvings":—

Page 154.—After the word carvings, in line two, add, "In the native drawing on the rock the pubes are shown, thus making the sex unmistakable. It should be stated that aboriginal drawings of females are uncommon, both in paintings and carvings, and are therefore all the more valuable."

Page 154.—Add the following note to the description of Fig. 14. Plate IX.: Since Plate IX. was printed, I have revisited the rock containing this carving, and on removing the earth and rubbish, with which it was partially covered, and sweeping the surface, I discovered the outline of another emu above the one shown in the Plate. What I at first supposed was part of a spear or club held in the hand of one of the men, I now find is the leg of the emu recently discovered. I have since contributed a paper to the "Journal of the Royal Society of N.S.W." (Vol. xxviii.), in which this group will be shown in its complete state.

Page 152.—Line fourteen and fifteen for "365-374" read "565-574."

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besides those I have mentioned, in the hope of hearing of other cave paintings.

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## ART. XII.—*Note on the Occurrence of Fossil Bones at Werribee.*

By G. B. PRITCHARD.

[Read 12th July, 1894.]

A short time ago having heard that some bones had been discovered during the excavation of the drains for the Werribee Sewage Farm, by the Metropolitan Board of Works, I called upon Mr. C. E. Oliver, M.C.E., Superintending Engineer of Sewerage, in whose possession the fossils were, and through his kindness and courtesy I was allowed the privilege of an examination which resulted in their identification. These identifications I now wish to place on record.

### PHASCOLOMYS PLIOCENUS, McCoy.

The first specimen is the lower jaw of the extinct wombat, *Phascolomys pliocenus*, *McCoy*, which agreed remarkably well with the admirable figure and description given by Sir F. McCoy in the Prodromus of the Palæontology of Victoria, Decade I., p. 21, plates III., IV., V. This specimen was in an excellent state of preservation, the only flaws being the absence of portions of the ascending rami and the distal ends of the two incisors, the cause being no doubt due to insufficient care being exerted during its excavation. In the Prodromus, this species is recorded from the gold drift of Dunolly, and from the shores of Lake Bullen Merri, Camperdown. In an essay "On the recent Zoology and Palæontology of Victoria," by Sir F. McCoy,* it is further recorded from the red clays of Lake Timboon. By examining the specimens in the National Museum, Melbourne, the following additional localities may be noted:—Limeburners Point, Geelong; Modewarre, Geelong; Bet-Bet, near Avoca; and a half of a lower jaw has been picked up on the beach two miles west of the Werribee River.

### ? PALORCHESTES AZAEL, Owen.

The second specimen was in a very fragmentary condition when it came into my hands, having been badly broken by the

* Intercolonial Exhibition Essays, 1866-67, p. 15.

pick; however, as all the fragments appeared to belong to the one bone, an endeavour was made by Mr. T. S. Hall and myself to piece them together, which was, we were glad to find, eventually successful. This proved to be the *tibia* of the gigantic extinct kangaroo, for which the genus *Palorchestes* was founded by Sir Richard Owen. The first specimen which came under the notice of that distinguished authority, was a portion of a skull discovered in 1851, by Dr. Ludwig Becker, "in a bed of yellowish sand and clay, mixed with very small shells, in the Province of Victoria, Australia."

A fragment eight and a half inches in length of the proximal end of a tibia, referred to this genus, is described and figured in the Philosophical Transactions,* and in Owen's "Fossil Mammals of Australia," p. 495, pl. cxxxi., and with this as far as it goes our example agrees accurately, the latter, however, is quite twenty-four inches in length, and is about five inches in circumference at its narrowest part. I refer this example to the above species with but little doubt, as it is the type and only species of the genus, and Mr. R. Lydekker says† it "is the largest known member of the family *(Macropodidæ)*, the length of the entire cranium being estimated at sixteen inches," and on account of the very large size of the skull he further remarks‡ that this "indicates that the largest limb bones probably belongs to that genus."

Judging from the specimens recorded by Sir R. Owen in the works cited above, and by R. Lydekker, in the British Museum Catalogue,§ we are fortunate in possessing such a fine example of this bone.

The exact locality from which the above bones have been procured was given me by Mr. C. E. Oliver, and is the Werribee Sewage Farm, 2 miles 39 chains 87 links on drain 55 east, 3 feet below the surface in a slightly calcareous red sandy clay.

Both specimens are now in the Biological Museum at the University.

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* Phil. Trans., 1876, p. 203, pl. xxiv.

† Brit. Mus. Cat. Fossil Mammalia, part v., p. 237.

‡ *Op. cit.*, p. 239.

§ *Op. cit.*, p. 244.

# ART. XIII.—*The Entomogenous Fungi of Victoria.*

By D. McALPINE and W. H. F. HILL.

[Read 9th August, 1894.]

## I.

## INTRODUCTORY.

Entomogenous Fungi, or fungi parasitic upon insects, have not hitherto received the attention in this colony which their importance deserves. Only eleven species are recorded for Australia, and six of these belong to Victoria, and yet there are quite a number awaiting the attention of the patient investigator. Dr. Cooke, in his *Handbook of Australian Fungi*, and in his popular volume on *Vegetable Wasps and Plant Worms*, has given us a more or less full account of these; but to anyone willing to take up the subject, there is a wide field for extended observation and description on the spot. We have attempted a beginning by way of extending our knowledge in this fascinating region, and trust that mycologists and entomologists may combine in unearthing the numerous forms of Entomogenous Fungi, which seem to flourish unrecorded in our midst. The subject has a dual aspect, as the name denotes. There is the entomological side in which the insects attacked by fungi are considered, and the mycological side in which the fungi attacking the insects are studied. To do full justice to the subject, both sides have to receive attention, the nature and habits of the insect being necessary for the proper understanding of the life-history of the fungus, and the fungi themselves vary according to the habits of the insects attacked. One of us is mainly responsible for the mycological portion, while the other has made careful study of the entomological part.

In addition to the entomological and mycological aspect, there is also an economic one, for apart altogether from the scientific investigation of these fungus-bearing insects and insect-destroying fungi, the subject has very important practical bearings. Every one is familiar with the common house-fly, transfixed to the

window pane or other smooth surface, with a white halo around the body, caused by the fly-mould known as *Empusa Muscae*, Cohn; and the muscardine or silk-worm disease is also well known, whereby the silk-worms become mummified, as it were, and so hard as to snap when bent. This is caused by a white mould known as *Botrytis Bassiana*, Bals., which fills, absorbs and destroys the interior of the caterpillar, and appears on the surface as a woolly covering. It would be out of place here to pursue this subject further, but it may be noticed that the coccus of the orange, the locust, and the aphides or plant-lice have all their parasitic fungi, and it has been proposed in the case of the latter to use the fungus for reducing their numbers. *Botrytis tenella*, Sacc., is known to be very destructive to the larvæ of the cock-chafer (*Melolontha vulgaris*) which is recognised in Britain as the most injurious of beetles to the agriculturist; but, perhaps, the most striking instance is that of the mealy isaria (*Isaria farinosa*, Fries.), which is a parasite of the *Cochylis ambiguella*, or raisin-worm as it is commonly called, and after the phylloxera, is one of the most destructive insects to the vine. M. Duchartre drew particular attention, in the Academy of France, last year to a communication from MM. Sauvageau and Perrand recording experiments on the destruction of the insects by means of the spores of the parasitic fungus. In the course of a few days all the larvæ became infected with the fungus and were mummified by it. Similar experiments tried in the vineyard gave a mortality of fifty per cent., and the spores were simply mixed with water and sprayed upon the vines. This pitting of nature against itself opens up a wide field for the destruction of injurious insects, as well as of other pests.

Even the element of romance is not wanting in connection with some of these forms, giving rise to wonderful tales of the transformation of plants into insects, and *vice versâ*. The famous Chinese plant-worm *Cordyceps sinensis*, Berk.) is mentioned by Dr. Pereira in his Materia Medica* as "summer plant, winter worm," and is reputed to possess wonderful medical properties. The whole subject is teeming with interest, and well deserves attention from the biological point of view.

* Materia Medica, vol. ii., 51 (4th ed.), 1853.

### Species Recorded for Victoria.

At present there are not many species of Entomogenous Fungi recorded as belonging to Australia. There are eleven species belonging to six genera altogether, and of these six species are found in Victoria, classified as follows :—

Group—Pyrenomycetes.

Order—Hypocreaceæ.

1. Cordyceps entomorrhiza, *Fries.*—Larvæ of insects (*Lepidoptera*).

1A. Cordyceps entomorrhiza, var. Menesteridis, Berk. and Muell.—Larva of *Menesteris laticollis.*

2. Cordyceps Gunnii, Berk.—Larva of some *Cossus* or *Hepialus.*

3. Cordyceps Taylori, *Sacc.*—Larvæ of insects.

Group—Phycomycetes.

Order—Entomophthoraceæ.

4. Empusa Muscae, Cohn.—Bodies of dead house-flies (*Musca-domestica*) and other dipterous insects.

Group—Hyphomycetes.

Order—Stilbeaceæ.

5. Stilbum Formicarum, Cooke and Mass. — Dead ants (*Formica*).

6. Isaria Cicadae, Miq.—Cicada.

In addition to the one described in this paper, several are awaiting determination, and very probably the number will be considerably added to when careful search is made for them.

### Literature and References.

The literature referring to the preceding species is rather scanty, and may be given in its entirety :—

1. Berkeley (M. J.)—"On some Entomogenous Sphæriæ." Hook, Lond. Journ. Bot. II., 1843.
   *Cordyceps Taylori* is described and figured.
2. Berkeley (M. J.)—"On some Entomogenous Sphæriæ." Hook, Lond. Jour. Bot. VII., 563, 1848.
   *C. Gunnii* noted.
3. Berkeley (M. J.)—" On some Entomogenous Sphæriæ." Jour. Linn. Soc. I., 1856.
   *Cordyceps Gunnii* and *C. Taylori* mentioned.

4. Berkeley (M. J.)—"Gardener's Chronicle." 791, 1878.
Description of *Cordyceps Menesteridis.*

5. Cooke (M. C.)—"Australian Fungi." Grev. XVIII., 8, 1889.
Description of *Stilbum Formicarum.*

6. Cooke (M. C.)—"Handbook of Australian Fungi." London, 1892.
Contains a technical description of all the Victorian species, with the exception of *Cordyceps Taylori.*

7. Cooke (M. C.)—"Vegetable Wasps and Plant Worms." S.P.C.K., London, 1892.
This is a popular account of fungi parasitic upon insects, and may be taken as a record of all known up to date.

8. Saccardo (P. A.)—"Sylloge Fungorum," I.-X. vols. Padua, 1882-92.
Contain description of all known fungi, including those of Australia.

9. Tisdall (H. T.)—"A Curious Fungus." Vict. Nat. VI., 1889.
Species of *Cordyceps* growing from an ant *(Formica corisobrina)* and found by Mr. C. French, F.L.S.

10. Tisdall (H. T.)—"On a species of *Isaria.*" Vict. Nat. X., 1893.
Found on a cocoon supposed to be that of the moth, *Darala ocellata.*

## Notes on Life History of Insect.

### Oncoptera intricata, Walker.

1. Ova.

Ovæ, taken from ovary, smooth, yellowish-brown, oval, about ·6 mm. diameter.

2. Larva.

Length, 5½ cm.

Head, black and polished.

Thoracic segments, black and hairless. First segment, a plain indurated collar. Second and third, plated with conspicuous, polished, chitinous prominences, arranged transversely.

Abdominal segments, nearly hairless, greenish-black with the exception of the tenth or terminal segment, which is distinctly black and polished.

The first and second are encircled by eighteen small rounded chitinous studs; the third, fourth, fifth, and sixth segments have each twelve; the seventh and eighth have sixteen; and the ninth has fourteen similar studs.

Habits.

The larva appears to be strictly nocturnal in its habits, and is usually found in low-lying country.

During the day time it hides in a little tunnel-like nest, made amongst the roots of a grass tussock. In connection with the nest the insect bores a vertical shaft, some six or eight inches deep, down which it retreats when alarmed.

Prior to its pupation, which takes place in July or August, the larva makes a vertical addition to its shaft, extending it upwards for an inch or two above the surface of the ground.

Specimens of these extensions are on the table, and may be seen to consist of a silk tube, 8 mm. in diameter, strengthened by an outer covering of grass, varying considerably, both in quantity of material, and mode of construction.

3. Pupa.

Red-brown, thorax and wing-cases darker, 25 × 6 mm., cylindrical, terminating abruptly.

When touched it shows great irritation and wriggles violently.

Ventral side of abdomen furnished with about thirty bristles, 3 mm. long, arranged nearly at right angles to the body, in three longitudinal lines, one median and two lateral.

The eighth segment projects slightly on the ventral side, bearing a hardened plate, set downwards at an angle of 45° with the body.

This organ, with the bristles on the ventral, and the adminiculæ on the dorsal surfaces, are probably of

use to the pupa in working its way from its underground retreat to the surface when about to emerge.

4. Imago.

Oncoptera intricata, Walk. (*Oncopera intricata*, Walk). Bombyces, 1559.

*Hepialus fasciculatus*, ib. Char. Und. Lep. (1869).

*Oncoptera intricata*, Meyr. Proc. Linn. Soc. N.S.W., 1124 (1889).

Mr. Meyrick gives the following description of the insect:—

"Male, 31-41 mm.; Female, 48 mm.

"Head, antennæ, thorax and abdomen, fuscous or ochreous "fuscous.

"Forewings sub-oblong, posteriorly somewhat dilated, "costa slightly arched, apex rounded, hindmargin "rounded obliquely, continuously with inner margin "ochreous, ochreous brown, slaty-grey, or dark fuscous; "generally more or less distinctly marbled with "irregular paler or whitish markings, including "rounded darker spots, sometimes marked with "blackish, but these markings are sometimes wholly "confused or obsolete; a pale oblique mark from "inner margin near base, margined on each side with "blackish, is generally conspicuous, but sometimes "obsolete; cilia with basal half ochreous brown, "terminal half white, sharply barred with dark "fuscous.

"Hindwings rather dark fuscous; costa in male suffused "with whitish ochreous or yellow ochreous, cilia as in "forewings.

"A very variable moth, but the basal mark is a good "characteristic.

"Posterior tibiæ in the male have long curved tufts of "hair, rising from above near base, and lying along "abdomen."

The perfect insect appears from the middle of September to the end of October, flying rapidly over the grass during the evening.

## Systematic Description of Fungus.

### Isaria Oncopteræ, McAlp. (n.s.).

This fungus attacks the larvæ of *Oncoptera intricata*, Walk. About twenty specimens were found near Melbourne, between August and October, inside the grassy tubes made by the larvæ, and in every case either on a level with the surface, or above it. All the infected larvæ observed were nearly full grown and dead, but in no instance were they found dead below the surface of the ground, although many tubes were examined, the larvæ being always alive and apparently healthy when found below the surface. The earliest stage at which the fungus was apparent was when it had killed the grub and filled its body with a mass of soft pithy mycelium of a pale yellowish colour, and covered the outside with a layer of ochrey down, consisting of hyphæ, and having no spores visible. In a day or two, when the specimen was kept in a moist atmosphere, little white processes burst through the skin, irregularly all over the body, increasing rapidly in length, and becoming purplish-pink, except at the apex which remained white. These processes—the stromæ—have a tendency to grow upwards, irrespective of the position of the dead larva. As many as fourteen stromæ grew from one specimen, but the average number is less. No spores could be found while the processes were at all purple in colour, but when full-grown, they turn brown, and then spores are easily discernible at and near the apex.

Isaria belongs to the group Hyphomycetes; but the species, parasitic on insects, are mostly conidial conditions of species of *Cordyceps*.

Cordyceps belongs to the Pyrenomycetes, and is generally regarded as including the conidial states, described under the form-genus of Isaria; but until the ascigerous stage is actually found, we prefer not to class them under that genus.

### Isaria Oncopteræ, McAlp. (n.sp.).

Growing from various parts of the body, dirty brown root colour, averaging $\frac{3}{4}$ to $1\frac{1}{2}$ inches high.

Stem branched, velvty, slender, tips of branches fertile. Conidia spindle-shaped to oval, hyaline, 12 $\mu$. x 6 $\mu$. borne on tips of hyphæ at right angles to the stroma.

On dead larvæ of *Oncoptera intricata*.

# ART. XIV.—*A new Australian Stone-making Fungus.*

## LACCOCEPHALUM BASILAPILOIDES, McAlp. and Tepp.

(Plate X.).

By D. McALPINE and J. G. O. TEPPER, F.L.S.

[Read 12th July, 1894.

This species of fungus belonging to the *Polyporaceæ* does not appear referable to any of the known genera of that order. It differs from *Boletus* in the tubes of the hymenophore not being separable from the sporophore and from *Strobilomyees* in the pileus not being scaly; from central-stemmed species of *Polyporus* in the promiscuously and peculiarly pitted pileus, as well as in being always hard and woody, and from *Polysticlus* by the absence of zones on the pileus. It is peculiar in forming large stony nodules at its base.

### *Genus* LACCOCEPHALUM, McAlp.

Sporophore pileate, pitted, stem central; hymenophore inferior, consisting of closely-packed, parallel, cylindrical tubes, distinctly differentiated, but not separable, from sporophore; openings of tubes sub-rotund or oval; hymenium lining the cavities of the tubes, spores large, spherical, coloured.

This genus differs from *Polyporus*, to which it seems most nearly allied, in being hard and woody from the first, in the peculiarly pitted pileus and in the character of the spores. Name from the characteristic pitted surface of the pileus—λακκος, a pit and κεφαλη, the head.

### *Laccocephalum basilapiloides*, McAlp. and Tepp.

Solitary. Pileus woody, irregularly concave in the middle, remainder convex (concavo-convex), $3\frac{1}{4} - 3\frac{3}{4}$ in. in dia., about $\frac{5}{8}$ in. in thickest part, brownish fawn, surface pitted, pits in the middle relatively small, conical, irregularly scattered, surrounding

rows much larger, ovate to elliptical, deepest on the inner end; circumference sub-circular, broad marginal zone smooth, undulate, not pitted promiscuously or sometimes in some parts irregularly; ridges of pits and margin of pileus coffee-colour, the latter deeper in colour because thicker; inner substance of pileus thick, whitish, unchangeable. Hymenophore greyish-fawn to reddish-brown, solid, continuous with stem; tubes adnate, averaging one line in depth, slightly contracting towards opening; pores moderately large, crowded, unequal, sub-rotund to oval; spores spherical, orange-yellow, echinulate, 44-50 in. in dia.; spines conical, acute, 3 in. long. Stem compressed oval, $\frac{1}{2} \times \frac{3}{4}$ in. in dia.; [redacted] scarcely exceeding an

only slightly convex, the abraided surface allowing the threads of the profuse mycelium to be detected; it appears similarly to other specimens, to be much less impregnated internally by ferruginous matter than externally. The figured specimen described above was obtained through Mr. A. Molineux, F.L.S. (Secretary of the S. A. Agricultural Bureau), from the south-eastern border of S. Australia, and reported as having been found in typical mallee scrub. The mycelium forms the large permanent stony base, and apparently induces the oxide of iron contained in the soil to bind the mass (from the surface inwardly into a solid nodule. Such stony nodules have been brought to the notice of one of us (Mr. Tepper) on various occasions, by persons meeting them in clearing arenaceous mallee lands. One of an almost regularly oval-shape was obtained near Ardrossan, in Yorke's Peninsula,

ART. XIV.—*A new Australian Stone-making Fungus.*

LACCOCEPHALUM BASILAPILOIDES, McAlp. and Tepp.

(Plate X.).

By D. McALPINE and J. G. O. TEPPER, F.L.S.

[Read 12th July, 1894.

This species of fungus belonging to the *Polyporaceæ* does not appear referable

## ERRATA.

On page 167, in the tenth line from the top, for 44-50 in. read 44-50 $\mu$, and, in the eleventh line from the top, for 3 in. read 3 $\mu$.

On page 168, in the seventh line from the top, for Herotes read Xerotes.

..., but not separable, from sporophore; openings of tubes sub-rotund or oval; hymenium lining the cavities of the tubes, spores large, spherical, coloured.

This genus differs from *Polyporus*, to which it seems most nearly allied, in being hard and woody from the first, in the peculiarly pitted pileus and in the character of the spores. Name from the characteristic pitted surface of the pileus—λακκος, a pit and κεφαλη, the head.

*Laccocephalum basilapiloides*, McAlp. and Tepp.

Solitary. Pileus woody, irregularly concave in the middle, remainder convex (concavo-convex), 3¼ – 3¾ in. in dia., about ⅝ in. in thickest part, brownish fawn, surface pitted, pits in the middle relatively small, conical, irregularly scattered, surrounding

rows much larger, ovate to elliptical, deepest on the inner end; circumference sub-circular, broad marginal zone smooth, undulate, not pitted promiscuously or sometimes in some parts irregularly; ridges of pits and margin of pileus coffee-colour, the latter deeper in colour because thicker; inner substance of pileus thick, whitish, unchangeable. Hymenophore greyish-fawn to reddish-brown, solid, continuous with stem; tubes adnate, averaging one line in depth, slightly contracting towards opening; pores moderately large, crowded, unequal, sub-rotund to oval; spores spherical, orange-yellow, echinulate, 44-50 in. in dia.; spines conical, acute, 3 in. long. Stem compressed oval, $\frac{1}{2} \times \frac{3}{4}$ in. in dia.; length from basal collar to hymenophore scarcely exceeding an inch, dirty fawn colour, spongy, fibrous striate, hardened like pileus, rising abruptly from an irregular, cushion-like collar of solid whitish mycelium, crowning a large, irregularly sub-conical basal part 3 in. in height; base sub-oval, $3\frac{1}{4} \times 4$ in. in dia.

The specific name has reference to this basal stone-like portion. This basal portion resembles a concretion of ferruginous sandstone in appearance and almost in density (the weight of the whole, fungus and all, $13\frac{1}{4}$ oz.) being apparently composed of the firmly agglutinated grains of the sandy soil in which it was formed, and thus fixed by the mycelium.

The upper surface is studded in many places by pappilate protuberances, and shows in the figured specimen also fragments of roots and the vestiges of an ant tunnel. The underside is only slightly convex, the abraided surface allowing the threads of the profuse mycelium to be detected; it appears similarly to other specimens, to be much less impregnated internally by ferruginous matter than externally. The figured specimen described above was obtained through Mr. A. Molineux, F.L.S. (Secretary of the S. A. Agricultural Bureau), from the south-eastern border of S. Australia, and reported as having been found in typical mallee scrub. The mycelium forms the large permanent stony base, and apparently induces the oxide of iron contained in the soil to bind the mass (from the surface inwardly into a solid nodule. Such stony nodules have been brought to the notice of one of us (Mr. Tepper) on various occasions, by persons meeting them in clearing arenaceous mallee lands. One of an almost regularly oval-shape was obtained near Ardrossan, in Yorke's Peninsula,

some twelve years ago, and subsequently exhibited at a meeting of the Royal Society, S.A. Two other nodules in his possession almost perfectly resemble tubers of potatoes, and were sent by Mr. J. G. Neuman, from Murray Bridge, in 1890, with the information that similar specimens of various sizes were often met with among the roots of tufts of sedges, etc., such as *Lepidosperma*, Herotes and Cladium in sandy soil. Both the latter are muddy-brown outside, and sandy-grey internally, quite hard and stony, but not as heavy as real sandstone. It will be noted that the upper end shows plainly the area of attachment of the stem and collar. These stone-like nodules have not been hitherto associated with fungi. The well-known Fungus stone *(Pietra Funghaia)*, which is used in Italy for the propagation of *Polyporus tuberaster*, is simply a ball of earth or sort of tufa matted together by mycelium, the dense masses of which have the property of compactly binding together the loose particles of earth. A Queensland Polyporus *(P. tumulosus, Cooke)*, has also a somewhat similar property. "On the hard stony ridges about Brisbane, when trenching the land large masses of mycelium are often met with. Some of the masses would weigh over a hundred-weight. From its consistency one might fancy that a quantity of dough had been buried."* Like other Australian mysteries, such as that of the so-called Native Bread, the origin of the stony nodules is now solved by means of the described and figured specimen, and the geologist of the future may yet have to turn to fungi for an explanation of some of the puzzling concretionary forms occasionally met with.

* Cooke Grevillea, xvii., p. 55, 1889.

## ART. XV.—*Cremation and Burial in relation to Death Certification.*

By H. K. RUSDEN.

[Read 9th August, 1894.]

It has been alleged that the success of an occasional exhumation and autopsy in the detection of poisoning, constitutes an argument against cremation, and I consider it important that the fallacy of that statement should be thoroughly exposed. Such cases, otherwise, have the unfortunate effect of producing an impression that while such resources exist, there is ample security against poisoning, which is very far from being the case; and that impression operates simply as a delusion and a snare. For it is entirely overlooked that such expedients are but clumsy and inadequate attempts to atone for previous neglect. When delayed for but a limited period they fail to detect all but practically three metallic poisons—arsenic, antimony, and mercury; as the numerous vegetable poisons soon disappear; and, in any case, a deferred autopsy is a disgusting and defective resource. No one but an utterly ignorant person would use arsenic, as it is known to remain for years. But prevention is always far better than cure, and a sufficient examination should always be made *before decomposition and burial.* Not only would the majority of poisons disappear by delay, but it is obviously quite possible that the body itself might be removed after burial, and examination be so prevented.

Cremation as practised in Europe, and proposed here, involves far less risk of impunity for poisoners, than exists under the present system of burial. At Milan, for instance, the parents of a deceased child had obtained all the certificates required for its burial, before it occurred to them to have it cremated. The stricter examinations, however, required for cremation, demonstrated the fact that the child had been poisoned, accidentally, by sweetmeats containing copper. This significant fact not only proved the superiority of the checks used in cremation, but it

# ART. XV.—*Cremation and Burial in relation to Death Certification.*

By H. K. RUSDEN.

[Read 9th August, 1894.]

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also forcibly illustrates the statement made by Judge Williams, on the 30th November, 1893, in the Melbourne Athenæum, that "*scores of people are poisoned and laid in the ground, and the crimes are never detected.*" The same opinion is held by many persons, whose opportunities for judging are above the average. The evidence given last year before the committee appointed by the House of Commons, to enquire into the lax system of death certification, directly corroborates the judge's statement, as any one may see in the *British Medical Journal* for April, May and June, 1893. It was proved that medical certificates of the cause of death were commonly given for 2s. 6d. each, upon the statement of an alleged witness of the death, but without the certifier seeing the corpse; and, that the supposed deceased was alive and well, though the insurance upon his or her life had been paid! It was also stated that some practitioners used printed forms of their own, coloured and printed in simulation of the death certificate forms issued gratuitously by the Registrar-General, but omitting the clause stating that the certifier had attended the deceased in his last illness! The consequent frauds upon Insurance Companies were neither few nor infrequent. From fifteen to twenty thousand persons are buried yearly in England without any medical certificate or enquiry.

In Victoria, a confiding public believes that a medical certificate of the cause of death is given in every case, and that the resulting security to human life is ample, notwithstanding Judge Williams' startling statement. But it is a fact, however incredible it may seem, that there is here *no statutory provision for such a certificate at all;* and, although, death certificates are received by Registrars (for merely statistical purposes only), yet, for the security of human life, they are worthless! When there is a medical attendant, the certificate is generally signed by him; when there is no medical attendant, the certificate is accepted from any person attending or present at the death, or the occupier of the house in which it occurred, or a clergyman. But it is entirely overlooked when accepting (as indispensable for statistical purposes) the certificate of the medical attendant, that as his conduct in that capacity is always liable to be called in question, his own guarantee of it can be worth no more than that of any accountant of the correctness of his own accounts, when

called in question; that is—*nil!* It is absolutely worthless for all practical purposes; yet a medical attendant's certificate is, as a rule, accepted—alone—as the best possible!

Ordinary medical certificates of the cause of death are worthless, on the ground also of *indefiniteness.* Of what worth in such a document (for any purpose) is such a word—for instance—as "enteritis," which is commonly used, and which would cover—I learn from an expert—ninety-nine cases in a hundred of poisoning, accidental or deliberate! For these reasons the present system simply offers a premium to murder.

It may be asked—Is it really necessary to have an expensive autopsy in every case of death? By no means. Sir H. Thompson, in his "Modern Cremation," has carefully estimated the percentage of cases in which there is room for doubt as to the cause of death—at one in a hundred. One autopsy in every hundred cases would not be too much to pay for, for the security all round, attained; and would in any case be trifling, compared to one exhumation and more difficult autopsy afterwards.

But the common ignorant objection to an autopsy, arises here for consideration. An antipathy, if harmless, may be defensible. But society has only itself to rely upon; and has an admitted interest, right, and duty, in claiming an autopsy for the general security against poison, etc., for the protection of human life; and what is more—in suspecting an objector of having a motive which itself should constitute an ample ground for insisting upon an autopsy. Such a suspicion should at once over-rule the objection of any person, if it failed to prevent him from making it.

Few people are prepared to believe how absolutely unprotected we are against murder; but Judge Williams' statement is no exaggeration. There is at present no guarantee that any one of us may not be poisoned and buried next week, without any enquiry whatever; provided that a registered practitioner, drunk or sober, wise or foolish, give a true but vague certificate of the cause of death—as "enteritis," after poisoning a patient—accidentally or deliberately! People forget that by insuring their lives, or making their wills, they give to others a *direct interest in their deaths*, and that there are plenty of unsuspected unscrupulous persons going about, to take advantage of the facilities afforded. Any invalid or feeble person is absolutely at their mercy, or

rather in their power. He can at present best protect himself by carefully providing for a particular examination of his corpse *before* burial, even if he suspect nothing. Let those concerned look to it.

The dismissal on Black Wednesday, in 1878, of all the country coroners, who have never been replaced, must have materially increased these risks to the provincial pouplation.

The precautions which Cremationists recommend, and for their own protection, take, make cremation far safer now than burial, as I think I have shown; for burial, under the present lax and absurd system, offers—I repeat, a premium to murder; and if the apathy of the people may be excused by ignorance or thoughtlessness, the neglect of those to whom they entrust such matters seems the more culpable.

The Cremation Committee of the Royal Society of Victoria strongly recommended that no system (of disposing of the dead) be tolerated, which does not provide amply strict examinations to obviate the possibility of such facts passing undetected.

# ART. XVI.—*An Attempt to Estimate the Population of Melbourne at the present time.*

By JAMES JAMIESON, M.D.

[Read 13th September, 1894.]

In a new country like Victoria changes in the population are rapid, not merely in the total number, but also in respect of its constitution as regards age and sex. It is unfortunate that the census is taken only at such long intervals as ten years, since changes, which can hardly be estimated correctly, may have taken place long before that period has elapsed. The Government Statist, making the best use of data at his disposal, publishes monthly statements of the vital statistics of Melbourne and suburbs, and quarterly estimates of the population of the whole colony. But, as he admits, his estimates are only probabilities; because, though the number of births and deaths is matter of actual record, and must be almost exact, the arrivals and departures, by sea and across the border, cannot be known with like exactness. At one time, therefore, the increase of population may easily be greater, and at another less than is supposed. And if the totals for the whole colony are thus rather uncertain, still more must there be liability to doubt about changes in the distribution of the population in particular localities, unless some careful local census is taken at short intervals. It is obvious to anyone who travels about the city and its suburbs that there has been a large reduction in the population of Melbourne during the last two years at least. Mr. Hayter's calculation is that while, at the census in April, 1891, the number was 490,896, it had fallen, on 31st December, 1893, to 444,832, a decrease of no fewer than 46,064 persons in two and three-quarter years. In arriving at his estimate for the later date, Mr. Hayter has to depend on figures supplied by the municipal authorities in the various districts. These figures again are not arrived at on any uniform system. In some there is an actual rough census, taken by the officials when making valuations or collecting rates; and in others the calculation is based on the number of premises, known or assumed to be unoccupied, allowance being made for the average number of persons to each house, as ascertained at the

last census. These returns from the municipalities date back to about September last, the figures being adjusted in the Government Statist's office, and brought up to the end of the year.

That the figures thus obtained are liable to considerable uncertainty must, I think, be admitted. It may be interesting, therefore, at a time when the country is taking stock of its resources, to test the correctness of these estimates by an altogether independent method.

The birth rate in any community is a tolerably fixed quantity. Taking the three years, 1890-92, as an example, it appears that in Victoria the birth rate averaged 33·24 per 1000, with extremes of 33·60, and 32·54. The rate does vary, of course, but only to a slight extent within any short period. The probability, therefore, is, that if the rate seems to vary greatly, within a very short period, there is some error in the figures used, the most likely source of error being in the population figure, the number of births, being matter of almost exact record. It is this test of the birth rate, or, rather, the variation in the births recorded, which I propose to apply for arriving at an estimate of the population of Melbourne in the present year. For this purpose I will take the first half of several successive years for comparison.

Table I.

Showing the Number of Births Registered in Melbourne and Suburbs for 1890-94.

| | 1890. | 1891. | 1892. | 1893. | 1894. |
|---|---|---|---|---|---|
| January - | 1251 | 1316 | 1429 | 1288 | 1123 |
| February - | 1480 | 1259 | 1443 | 1227 | 1057 |
| March - - | 1540 | 1338 | 1649 | 1353 | 1259 |
| April - - | 1478 | 1648 | 1297 | 1273 | 1123 |
| May - - | 1612 | 1641 | 1657 | 1369 | 1251 |
| June - - | 1675 | 1628 | 1470 | 1411 | 1142 |
| | 8957 | 8830 | 8945 | 7921 | 6955 |

The census population, at 5th April, 1891, can be taken as providing a correct birth rate for the first half of that year, viz., 17·987 per 1000. Taking that rate as a standard, and applying it to 1894, we can proceed to calculate back to the population which would provide the number of births recorded, viz., 6955. The figure of population thus brought out is 386,668. It is of course a mere assumption that the birth rate of 1894 was the same as that of 1891, and it cannot be claimed for these figures, therefore, that they are free from error. The question remains then whether their correctness can be submitted to test.

The death rate is, on the whole, a more variable quantity, from year to year, than that of births, and if it cannot therefore be so safely used for purposes of comparison, it may still be applied as a check in a similar way.

TABLE II.

Showing the number of Deaths Registered in Melbourne and Suburbs for 1890-94.

| | 1890. | 1891. | 1892. | 1893. | 1894. |
|---|---|---|---|---|---|
| January - | 998 | 874 | 776 | 702 | 718 |
| February - | 878 | 733 | 698 | 665 | 599 |
| March - - | 995 | 792 | 862 | 696 | 623 |
| April - - | 973 | 749 | 645 | 632 | 530 |
| May - - | 797 | 654 | 607 | 518 | 537 |
| June - - | 651 | 649 | 614 | 631 | 493 |
| | 5294 | 4451 | 4202 | 3844 | 3500 |

Taking again the year 1891, as that for which we have exact figures, it appears that the death rate for the first half of that year was 9·06 per 1000. And using that rate as our basis it results, that the population needed to produce the number of deaths in the first half of 1894, viz., 3500, was 386,313. As this figure is almost identical with that arrived at on the basis of the

birth rate, it is fair to assume that the actual population in the first half of the present year, approached nearly to that which has now been calculated out.

It might be supposed that it would have been a safer procedure to take the three years, 1890-92, as the basis of calculation as supplying greater probability of a fair average. I do not think, however, that this is actually the case. It would be necessary to assume that the population of 1891 was the proper average of the three years, and almost certainly this was not the case. For though the population doubtless increased from 1890 to 1891, there can be as little doubt that, instead of increasing further, it had already began to fall off in 1892. This would introduce an element of error into any calculation of either birth or death rate for the three years. And, in the case of the death rate, there would be another source of error, in the fact that 1890 was a year with an exceptionally high mortality, as a glance at the figures in Table II. sufficiently shows.

But though the concurrence of results, on the two modes of reckoning, is remarkable, it must be recognised that with each of them there is liability to fallacy. In times of severe depression it is quite to be expected that there should be some lowering of the birth rate, not of course very quickly produced, and mainly by the previous production of a lowered marriage rate. There has, in fact, been a large reduction in the number of marriages in Melbourne recently, from 5172, in 1890, to 4872, in 1891; 4135 in 1892; and 3635 in 1893. This reduction in the marriages doubtless came to affect, in some degree, the number of births, though a reduction of about 500 marriages annually does not go very far to account for an annual diminution of births of about 2000 in 1893 as compared with 1892; and of as many more, to all appearance, in 1894.

As was already said, there is even greater liability to fallacy in using the death rate as a basis of calculation. And it has to be admitted that the public health was, on the whole, better in the first half of the present year than in the earlier years of the decade. It has been remarked in England that times of trade depression are commonly enough associated with a low rate of mortality. In fact, depression in England or in Australia is hardly such as to be a cause of disease or death to appreciable

extent, as it shows itself to be in countries such as India, where depression becomes actual famine. It is doubtful, indeed, whether depression, such as we suffer from, has any very direct influence on the public health. It is chiefly the degree of prevalence of epidemic diseases which causes variations of the death rate, and some of these were more largely prevalent in 1890-92 than in the present year. A mere reduction of the number of births, too, has a distinct effect in lessening the death rate, the mortality among young infants being eight or nine times greater than it is among the population as a whole. I do not wish to load this paper with figures not strictly relevant to the main issue, and will therefore content myself with these hints, and admit that the death rate probably was lower in the first half of 1894, than in 1891. That calculations, based on the number of deaths in that year are thus to some extent vitiated, may also be admitted. But that the population of Melbourne has been largely reduced in the present year, in addition to any previous losses cannot be doubted. To get as small a number of births and deaths as are now recorded we have to go back to 1886, when the population, according to Mr. Hayter's estimate, amounted only to 371,630. It does not, therefore, seem to be an extravagant statement, that the population of Melbourne and suburbs, at the present time, cannot greatly exceed the 386,000, which has, by calculation, been arrived at.

But many persons will be found to say that a lessening of population in the metropolis is not a thing to be greatly lamented, if there has been a mere transfer to other parts of the colony. A comparison of the births and deaths in the first half of successive years, in Melbourne and suburbs on the one hand, and in all the rest of the colony on the other, will help to show whether or not this has been the case.

TABLE III.

Showing Births and Deaths in first half of years 1890-94 in Melbourne and rest of Colony separately, and in Victoria as a whole.

BIRTHS.

| | 1890. | 1891. | 1892. | 1893. | 1894. |
|---|---|---|---|---|---|
| Melbourne - | 8,957 | 8,830 | 8,945 | 7,921 | 6,955 |
| Rest of Colony | 9,609 | 9,771 | 9,856 | 10,386 | 9,987 |
| All Victoria - | 18,566 | 18,601 | 18,801 | 18,307 | 16,942 |

DEATHS.

| | 1890. | 1891. | 1892. | 1893. | 1894. |
|---|---|---|---|---|---|
| Melbourne - | 5,294 | 4,451 | 4,202 | 3,844 | 3,500 |
| Rest of Colony | 4,936 | 4,191 | 4,533 | 4,316 | 4,493 |
| All Victoria - | 10,230 | 8,642 | 8,735 | 8,160 | 7,993 |

Certainly these figures show that there has been a marked difference of conditions prevailing in the metropolitan and extra-metropolitan portions of the colony. We are entitled to infer that there has been, at least, no loss of population in the latter portion, since 1891. And if there actually has been a lower than average birth and death rate in the one portion, the same has doubtless been true of the other. In that case, what looks like fixity of population may really indicate some increase. According to Mr. Hayter's estimate, the population of extra-metropolitan Victoria, on 31st December, 1893, was 729,174; while it was only 649,509 at the census in April, 1891. It would be a satisfaction to be able to believe that there was an increase of almost 80,000 persons in the two and three-quarter years; but, in

the face of the figures given in Table III., it is hardly possible to accept the estimate as a correct one. The explanation, doubtless, is that the unrecorded departures have been considerably more numerous than the official figures show. Considering the trials which Victoria has lately undergone, it is fair matter of congratulation, if her population, at the present time, is not less than it was in 1891.

ART. XVII.—*The Older Tertiaries of Maude, with an Indication of the Sequence of the Eocene Rocks of Victoria.*

By T. SERGEANT HALL, M.A. (Assistant Lecturer and Demonstrator in Biology in Melbourne University),
and
G. B. PRITCHARD (Lecturer in Geology, Workingmen's College, Melbourne).

[Read 13th September, 1894].

The sections of the tertiary rocks displayed in the valley of the Moorabool River, near Maude and to the northward, were early recognised as throwing considerable light on the correlation of beds which are separately better developed elsewhere. In 1866 Sir Alfred R. C. Selwyn reported to Parliament* on the age of the Victorian gold drifts, and the report was, in the following year, reprinted by him with reduced copies of the sections therein contained in the Exhibition Essays.†

On the evidence there detailed, the older volcanic rocks, the plant beds underlying them and certain non-auriferous gravels occurring in the neighbourhood of Maude, and elsewhere in the colony, were referred to the miocene of the survey, that is to our eocene. Mr. C. S. Wilkinson, assisted by Mr. R. A. F. Murray, made a minute geological survey of a part of the district, and the quarter-sheet (19 S.W.) which includes the most important part of the area, was published in 1865. Unfortunately the sheet of sections and explanatory notes, which should have accompanied the map, has never appeared. The results of our observations on the eocene bed at Curlewis‡, rendered it advisable that an early visit should be paid to the Maude district, and a recent vacation has afforded us the desired opportunity.

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* Votes and Proceedings of the Legislative Assembly of Victoria, 2nd Session, 1866, vol. i.
† Exhibition Essays, 1866-67, pp. 21-26.
‡ Proc. Roy. Soc. Vic., 1893, p. 18.

The eocene rocks occupy an area of slightly elevated ground flanking the ordovician rocks which extend south from Steiglitz. To the east, south, and west, the country is covered by an almost unbroken sheet of what is generally called the "Newer Volcanic Rock." The surface of the exposed eocene rises slightly above the level of the basaltic plain, and the geological boundary is marked on the west by the valley of the Moorabool River, and on the east by that of Sutherland's Creek, the two streams meeting a little to the south of the area. The eocene beds underlie the basaltic plains and are exposed wherever the streams have cut through the overlying rock, which extends from Port Phillip to beyond Hamilton in the west. The valleys of the two streams above alluded to are very striking features in the district. Aneroid measurements showed their depth to be about 250 feet in each case, and the Moorabool Valley averages about a mile in width, while that of Sutherland's Creek is slightly narrower. It is in the sections displayed along these steep sided valleys that the geology of the district can best be studied.

The bed rock of the immediate neighbourhood is ordovician, but granite outcrops frequently between the Anakie Hills and the Dog Rocks, near Geelong, both of which are composed of this rock. Aided by the quarter-sheet, we examined all the marine eocene outcrops we could find, and a description of the more instructive sections will make the structure of the district clearer.

On the Moorabool, a section line is indicated on the map crossing the valley, and passing through an outcrop of limestone underlying the older volcanic rock. This line we examined carefully. The surface soil on the east of the valley is very sandy, so that there is at first a very gradual descent towards the stream. The section is approximately as follows:—

| | | |
|---|---|---|
| EOCENE— | | |
| Sandstone passing down into limestone | ? 40 | feet. |
| Limestone ... ... ... | 10 | ,, |
| Older volcanic ... ... ... | 120 | ,, |
| Sandy limestone and conglomerate ... | 30 | ,, |
| ORDOVICIAN— | | |
| Slates and sandstones ... ... | 40 | ,, |
| | 240 | feet. |

The sandstone capping the hill covers the whole of the area between the two streams, excepting in one or two places where an outlier of newer volcanic rock overlies it, or where minor valleys have cut through it. It gradually passes down into limestone which is in places largely composed of polyzoa and echini spines. The base of the limestone rests on the surface of the basalt, which, though approximately level when taken as a whole, is carved into steep and irregular depressions. The lower part of the limestone is full of well rounded basalt fragments, from mere pebbles up to blocks of great size. Close to the junction, and extending up from it for a variable distance in the different sections, the limestone is altered to a hard pink crystalline rock, which is described by Professor Sir F. McCoy as in some places "closely resembling lithographic stone."*

This rock is full of fossils, but for the most part they exist as casts only. They consist of trochiform shells, haliotis, cerithium, and such forms as to-day live on the rocky, bouldery parts of our coasts. That the Maude fossils are littoral forms has been pointed out by Sir Fredk. McCoy.† The talus blocks of this hard limestone are thickly strewn over the slopes below the outcrop, and dozens of specimens, picked up at random and broken with the hammer, displayed, in nearly every instance, rounded fragments of basalt embedded in the mass. In no single section did we find any evidence of the intercalation of a thin sheet of basalt. We inspected every outcrop we could find, and they were many, and followed the valley some distance south of the boundary of the quarter-sheet into unmapped country, but could find no sign of the basalt which is represented on the map as overlying the limestone, and as being in its turn overlain by other "miocene" (eocene) beds. The numerous small quarries for limestone showed over and over again, rounded pebbles and blocks of basalt scattered through the rock. As we go up from the basalt we find the limestone becoming less and less altered, till it assumes the character of the ordinary polyzoal rock, that is a rock of which the well-known Waurn Ponds building-stone may be taken as the lithological type. In this comparatively unaltered rock basalt fragments occur, but are not as numerous

* Prod. Pal. Vic., Dec. III., p. 24. † *Id.* p. 23.

as in the lower portion, and are often associated with small quartz pebbles. In a section displayed on the roadside between the State School and the old mill, at The Clyde, we measured one embedded basalt block exposed, and found it ten feet long and four feet thick. Another boulder was five feet by three feet six inches; and these great masses were associated with numerous fragments of all sizes, down to small pebbles; and all were well rounded. Packed in between the boulders was a deposit of comminuted polyzoa, broken and worn spines of echini, fragments of brachiopod shells and of pectens, but perfect specimens of any kind were rare.

It may be that the officers of the survey felt the necessity of accounting for the alteration of the rock to a crystalline limestone by igneous action, and were led to attribute it to an intercalated flow, taking the large included blocks as portions of such a sheet. The subsequently opened sections, however, dispose entirely of such an interpretation. On the opposite side of the river from this Clyde section, a large quarry is a conspicuous object on the hillside. This shows a clean face of nearly thirty feet, and is about fifty yards in length. The limestone, which forms the greater part of the quarry floor, rests on a very uneven basaltic surface, and extends about ten feet up the face. It is distinctly less altered as we go up from the volcanic rock, and is capped by arenaceous and calcareous beds, which reach apparently to the top of the hill. The cause of the change in character has, then, evidently acted from below, and is not due to a more recent flow of basalt. What this cause may have been is not clear to us, but we have recorded a similar alteration in the polyzoal rock overlying the ash beds of Curlewis.* Mr. D. Avery, M.Sc., has kindly examined the rock for us, and says there is only a very small amount of magnesia present, so that the changed character has not been brought about by dolomitisation.

Wherever the limestone is unaltered it is seen to be, both lithologically and palæontologically, the equivalent of that of Waurn Ponds.

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* Proc. Roy. Soc. Vic., 1893, p. 3.

## Comparative Table between Upper Maude Beds, and Waurn Ponds.

| Name of Specimen. | Upper Maude Beds. | Waurn Ponds. |
|---|---|---|
| ZOANTHARIA. | | |
| Placotrochus elongatus, Duncan - - | - | X |
| Notocyathus australis, Duncan - - | X | - |
| Balanophyllia australiense, Duncan - - | X | - |
| Graphularia senescens, Tate - - - | - | X |
| Isis, 2 spp. - - - - - - | - | X |
| ECHINODERMATA. | | |
| Echinobrissus vincentianus, Tate - - | X | - |
| Echinobrissus australiæ, Duncan - - | - | X |
| Echinobrissus n. sp. ? - - - | - | X |
| Paradoxechinus novus, Laube - - | X | - |
| Echinolampas posterocrassus, Gregory | †X | X |
| Psammechinus Woodsii, Laube - - | †X | X |
| Scutellina patella, Tate - - - | †X | X |
| Schizaster abductus, Tate - - - | ‡X | - |
| ? Toxobrissus sp. - - - - | X | X |
| Pericosmus Nelsoni, McCoy - - - | - | X |
| Eupatagus murrayanus - - - | - | X |
| Holaster australis, Duncan - - - | - | X |
| Cyclaster archeri, T. Woods - - - | - | X |
| Cidaroid plates and spines - - - | X | X |
| CRUSTACEA. | | |
| ? Balanus sp. - - - - - - | X | X |
| Crab remains - - - - - - | X | - |
| POLYZOA - - - - - - - | Abundant | Abundant |
| PALLIOBRANCHIATA. | | |
| Waldheimia furcata, Tate - - - | X | X |
| Waldheimia grandis, T. Woods - - | X | X |
| Waldheimia insolita, T. Woods - - | - | X |
| Waldheimia tateana, T Woods - - | X | - |
| Waldheimia corioensis, McCoy - - | - | X |
| Waldheimia garibaldiana, Davidson - | - | X |
| Terebratula vitreoides, T. Woods - - | - | X |
| Rhynchonella squamosa, Hutton - - | X | X |
| Terebratulina scoulari, Tate - - - | X | X |
| Magasella compta, G. B. Sowerby - - | X | X |
| Crania quadrangularis, Tate - - - | X | X |
| Terebratella n.sp. aff. pentagonalis - - | X | - |
| Terebratella (?) sp. nov. - - - | X | - |
| LAMELLIBRANCHIATA. | | |
| Ostrea sp. - - - - - - | X | X |
| Placunanomia ione, Gray - - - | - | X |
| Dimya dissimilis, Tate - - - | X | X |
| Pecten foulcheri, T. Woods - - - | X | X |
| Pecten murrayanus, Tate - - - | - | X |
| Pecten polymorphoides, Zittel - - | X | - |

| Name of Specimens. | Upper Maude Beds. | Waurn Ponds. |
|---|---|---|
| Pecten yahlensis, T. Woods var. semilævis, McCoy | - | X |
| Pecten subbifrons, Tate | - | X |
| Pecten gambierensis, T. Woods | - | X |
| Pecten n.sp. aff., Eyrei | - | X |
| Lima Bassii, T. Woods | X | - |
| Limatula Jeffreysiana, Tate | X | - |
| Limatula crebresquamata, Tate M.S. | - | X |
| Spondylus pseudoradula, McCoy | X | X |
| Lucina n. sp. | X | - |
| GASTROPODA. | | |
| Triton tortirostris, Tate | X | - |
| Triton n.sp. | X | - |
| Voluta sp. (pullus) | X | - |
| Ancillaria pseudaustralis, Tate | X | - |
| Drilla 3. spp. | X | - |
| Conus heterospira, Tate | X | - |
| Cypræa spp. (casts) | X | X |
| Cypræa sp. (cast of a very large species, probably *C. gigas*) | X | X |
| Natica Mooraboolensis, Tate | X‡ | - |
| Thylacodes conohelix, T. Woods | X | X |
| Thylacodes n.sp. | X | - |
| Niso psila, T. Woods | X | - |
| Cerithium Flemingtonensis, McCoy | X | - |
| Cerithium sp. | X | - |
| Triforis, sp. | X | - |
| Liotia sp. aff. Roblini | X | - |
| Tinostoma n.sp. | X | - |
| Turbo ? n.sp. | X | - |
| Opercula of Trochoid shells | X | - |
| Pleurotomaria tertiaria, McCoy | X§ | - |
| Haliotis Mooraboolensis, McCoy | X§ | - |
| Haliotis ovinoides, McCoy | X§ | - |
| Scutus anatinus, Donovan | X‡ | - |
| PISCES. | | |
| Carcharodon megalodon, Agassiz. | - | X |
| Carcharodon angustifrons, Agassiz. | - | X |
| Lamna sp. | - | X |
| Oxyrhina sp. | X | X |
| Palate aff. Diodon. | - | X |
| MAMMALIA. | | |
| Ziphius (Dolichodon) Geelongensis, McCoy | - | X§ |
| Squalodon Wilkinsoni, McCoy | - | X§ |
| Cetotolites Leggei, McCoy | - | X§ |
| Cetotolites Nelsoni, McCoy | - | X§ |
| Cetotolites Pricei, McCoy | - | X§ |

NOTE.—Those marked § have been recorded by Sir F. McCoy, and ‡ y Professor Ralph Tate, and those marked † have been shown us by he Rev. A. W. Cresswell, M.A., who informs us he collected them from ne locality indicated.

N

SUMMARY.

| | Upper Maude Beds. | Waurn Ponds. |
|---|---|---|
| Zoantharia - - | 2 | 4 |
| Echinodermata - - | 8 | 11 |
| Crustacea - - - | 2 | 1 |
| Palliobranchiata - - | 9 | 10 |
| Lamellibranchiata - | 8 | 11 |
| Gastropoda - - | 26 | 3 |
| Pisces - - - | 1 | 5 |
| Mammalia - - | — | 5 |
| Total - - | 56 | 50 |

An inspection of the list of fossils from the Upper Maude Beds, and from Waurn Ponds, brings out the close relationship existing between them. The most noticeable difference is caused by the presence of gastropods in the former beds, but it should be noted, that nearly the whole of these were obtained from the section above mentioned, near the Clyde, on the east bank of the river, and from a deposit overlying the polyzoal rock. This overlying deposit really represents the clays occurring at the Filter Quarries, at Batesford*, where the majority of these gastropod species are well represented. The deposit is of a very peculiar nature, and at first sight looks like a sandy clay full of brown pisolitic ironstone pebbles. A closer inspection and the use of the acid bottle, show that it is really a calcareous clay, and that the supposed ironstone pebbles are nearly all recognisable as casts of fossils. Some of these preserve the external form, while others are merely internal casts. Gastropods, echinus spines and polyzoa are all found thus preserved, and the ornamentation of the mollusca is frequently well-shown. All the casts are highly glazed, and of a dark brown colour. They are easily separable

* See below, p. 193.

from the matrix, and are readily crushed between the fingers. It is then found that the ferruginous coat is very thin, and surrounds an earthy internal part of a light fawn colour, similar to the matrix in which the casts are embedded. We have not seen anything comparable to this method of fossilisation, and are at a loss for an explanation of the processes which have brought it about.

The older volcanic rock in the district is much decomposed, and towards its upper part is full of amygdules of carbonate of lime, while some lumps of radiating crystals of arragonite, about half-a-pound in weight, were found on the slopes. The soil produced from the decomposition of the basalt is very fertile, and the valley was formerly noted for its vineyards, which have, however, now entirely disappeared, having been uprooted when *phylloxera* was prevalent in the district some years ago.

Below the older basalt in the first section indicated, we find, as shown on the map, another outcrop of limestone, which is very variable in its composition. As a rule, it is arenaceous and earthy, and is in places full of casts while actual fossils are scarce. When they were obtained they were so encrusted with a strongly adhering calcareous coat that while we were gathering them we were rarely able to recognise them specifically, and were consequently quite in the dark as to the equivalence of the beds, especially as one of the commonest forms was a new species of *Trigonia*. There can however be no doubt, as an examination of the faunal list will show, that the limestone represents the lower portion of the Spring Creek section. As we approach the base of the limestone, fragments of slate and quartz make their appearance, and gradually become more abundant, till at length we find the limestone has disappeared, and a conglomerate of well-rounded pebbles has taken its place. In the limestone and conglomerate basalt pebbles are conspicuous by their absence, although we spent some time in a careful search for them. This fact, together with the considerable extent of the outcrop, its evident bedding, and the great change in fauna, precludes the idea of its being a talus. We did not, it is true, see the actual junction of limestone and overlying basalt; but, unhesitatingly, agree with the interpretation of Messrs. Selwyn, Wilkinson and Murray as regards their relationship.

This section then settles the age of the older volcanic rock. It is eocene. In a paper, read by ourselves, on 9th March of

last year* we stated that it would seem advisable to refer the older volcanic rock to two distinct periods, should it be found that it was anywhere intercalated with eocene rocks, as we showed that it was in some cases overlain by beds which had been referred to lower eocene. At a later date† we suggested that it might be found advisable to remove it altogether from the tertiary period. Messrs. Tate and Dennant, subsequently to our first paper,‡ stated that the older volcanic rock "may ultimately prove to be cretaceous;" while Professor Tate, in the tabular view of the Tertiary Strata of Australia, as given in his Presidential Address before the Adelaide Meeting of the Australasian Association, puts the older volcanic rock under the head of pre-eocene, while, by a strange oversight, the leaf beds underlying it are referred to the eocene period. There is, we now think, not sufficient evidence to suggest a subdivision of the volcanic rock, and certainly none for considering its age anything but eocene.

### Fossils from Lower Beds at Maude.

*Zoantharia.*

Placotrochus elongatus, Duncan.
Notocyathus australis, Duncan.
Bathyactis discus, T. Woods.

*Echinodermata.*

Maretia anomala, Duncan.
Monostychia sp.
Fibularia gregata, Tate.
Fibularia n.sp. (?)
Scutellina patella, Tate.

*Annelida.*

Serpula sp.

*Polyzoa.*

Well represented.

*Palliobranchiata.*

Magasella compta, G. B. Sowerby.
Terebratulina Scoulari, Tate.
Rhynchonella squamosa, Hutton.
Crania sp.

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* Proc. Roy. Soc. Vic., 1893, p. 1.
† Proc. Austr. Ass. Adv. Sci., Adelaide Meeting, p. 342.
‡ Proc. Roy. Soc. S. Aust., 1893, p. 212. Read 2nd May, 1893.

*Lamellibranchiata.*

Ostrea sp.
Dimya dissimilis, Tate.
Pecten consobrinus, Tate, var.
Pecten Foulcheri, T. Woods.
Limopsis insolita, G. B. Sowerby.
Limopsis Belcheri, Adams and Reeve.
Pectunculus Cainozoicus, T. Woods.
Cucullæa Corioensis, McCoy.
Trigonia n.sp. aff. semiundulata.
Cardita n.sp.
Lucina leucomomorpha, Tate.
Dosinia Johnstoni, Tate.
Myadora tenuilirata, Tate.
Corbula pyxidata, Tate.

*Gastropoda.*

Turritella conspicabilis, Tate.
Mathilda transenna, T. Woods.
Rissoina sp.
Tinostoma sp.
Solariella sp.
Cylichna exigua, T. Woods.

*Scaphopoda.*

Entalis subfissura, Tate.

*Pisces.*

Otoliths.

SUMMARY.

| | |
|---|---|
| Zoantharia ... ... ... | 3 |
| Echinodermata ... ... ... | 5 |
| Annelida ... ... ... | 1 |
| Palliobranchiata ... ... ... | 4 |
| Lamellibranchiata ... ... | 14 |
| Gastropoda ... ... ... | 6 |
| Scaphopoda ... ... ... | 1 |
| Pisces ... ... ... ... | 1 |
| | 35 |

In the mollusca proper of the above list there are only three which have not hitherto been recorded from Spring Creek, namely, one lamellibranch which is a new trigonia, the diagnostic characters of which will be published shortly, and two gastropods. With regard to the representatives of the other classes, the majority also occur at Spring Creek, or in beds belonging to an equally low horizon in the tertiary series. This obviously shows the close relationship existing between the Lower Maude and Spring Creek beds. Upon stratigraphical grounds the Lower Maude beds are evidently very low down in the tertiary series. Our previous work in the Geelong district had led us to suspect that this was also the case at Spring Creek.

If we look at the results to be obtained from a critical examination of the Spring Creek fossils we have satisfactory confirmation of the above.

Messrs. Tate and Dennant, in their correlation paper,* record 227 species of mollusca, of these we are only able to pick out three living species which gives *a percentage of 1.3*. One of the above living species, namely, *Nucula Grayi, D'Orbigny* [= *Nucula tumida, T. Woods*] is, however, not recognised as such by Professor Tate This identification has been made on a careful comparison of the living shells, dredged in Port Phillip Bay, with our fossil species. We have been able to add sixty-six molluscan species to the above referred to paper, making a total of 293, without increasing the number of living species, so that it seems perfectly safe for us to assert that the *percentage of living species in these beds is one*, or at most, very slightly over.

As the older basalt overlies beds of this horizon, and is overlaid unconformably by limestones of the Waurn Ponds type, and clays of the Lower Muddy Creek or Mornington type, the two latter conforming to one another with a gradual change in sediment where a junction is seen,† it will be of interest and importance to examine the results of the percentage theory as applied to the Muddy Creek beds. Messrs. Tate and Dennant, in the paper above referred to, state :—"Out of a total of 725 species of all classes from the two well-marked zones at Muddy Creek, 511 have been definitely traced to the lower beds. Of

* Trans. Roy. Soc. S.A., 1893.

† Proc. Roy. Soc. Vic., N.S., vol. iv., p. 11.

these, from six to eight still survive, and the percentage of recent to extinct forms is thus about one and a half." In the list of fossils appended to Messrs. Tate and Dennant's paper, there are only 250 mollusca from Muddy Creek, which is obviously incomplete. Mr. Dennant, in a much earlier paper,* refers 405 species of mollusca to the lower zone. There are at least *ten recent species* now known from these beds which gives a *percentage of nearly two and a half.* It is not quite clear whether the 511 species mentioned above is intended to indicate mollusca only, but even if this should be the case, as is likely, we would still have nearly two per cent. of living species, which decidedly indicates an horizon younger than the Spring Creek beds, and is confirmatory of the stratigraphical sequence already indicated.

The section at North Belmont shows a resemblance to the Spring Creek beds in the occurence of:—*Cucullaea Corioensis, McCoy*, *Trigonia semiundulata, McCoy*, *Chione Pritchardi, Tate m.s.*, and *Chione cainozoica, T. Woods*, and some common forms of echinoderms and palliobranchs, and may tentatively at least be placed on the same horizon until more evidence is forthcoming.

According to Sir Alfred Selwyn,† the beds containing plant remains pass under the marine tertiaries to the north of Maude, but our stay was too short to allow us any time for examining the evidence on this point. In the sections on Sutherland's Creek, to the eastward of the first sections we mentioned, we find the ordovician rocks overlain by nearly 100 feet of quartzite and sandstones. The grain of this rock is fairly fine, and we found no trace of gravel or conglomerate in the beds. The change from loose sand into fairly compact sandstone, and then into quartzite seems very irregular. At the point where the ordovician is lost sight of as we go south, the overlying series consists of a white or brown rock on which the hammer makes but little impression, so that the alteration has been effectually carried out. In some places higher up the stream the quartzite may be traced up to the top of the deposit, whilst in others, the upper part consists of loose sand. It is not quite clear whether the beds are the equivalents of the lower limestone of the Moorabool Valley above described, or of the plant beds, though the latter seems more probable.

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* Trans. Roy. Soc. S.A., 1888, p. 39, *et seq.*
† Exhibition Essays, 1866-67, pp. 21, *et seq.*

With regard to the occurrence of a quartzite in the tertiary series, Professor J. W. Dawson, in speaking of one overlying the eocene in Egypt, uses words which exactly apply to our rock.* "The Red Mountain, near Cairo, . . . is composed of a hard brown, reddish and white sandstone . . . In many parts it has the characters of a perfect quartzite, and appears at first sight extremely unlike a member of the tertiary series . . . The induration of the beds seems to be local, and to be connected with certain fumarole-like openings, which have probably been outlets of geysers or hot siliceous springs contemporaneous with the deposition of the sand." Perhaps the same cause has been efficient at Maude. A somewhat similar tertiary quartzite, it it may be mentioned, occurs at Keilor, but is higher in the series, and is capped by newer and not by older basalt.

Overlying the quartzites of Sutherland's Creek, we have the older volcanic rock, and over this again limestone of a similar nature to that already described in the previous section. On the eastern side of the valley this is in some places capped by the newer volcanic rock. Near the most southerly outcrop of the ordovician on Sutherland's Creek we found the section to be, approximately, as follows :—

| | | | |
|---|---|---|---|
| Newer volcanic | ... | ... | 40 feet. |
| Sandy limestone | ... | ... | 20 " |
| Older volcanic | ... | ... | 60 " |
| Quartzite and sandstone | | ... | 90 " |
| Ordovician slate | ... | ... | 40 " |
| | | | 250 |

THE SEQUENCE OF SOME OF THE VICTORIAN EOCENE BEDS.

The recognition of the fact that the sandy limestone underlying the older basalt of Maude, is practically the equivalent of the lower part of the Spring Creek section, and that the upper beds at Maude are the representatives of those at Waurn Ponds, supplies a hint that is of use in unravelling a good deal of the stratigraphical sequence of the eocenes, and we have gathered together a few facts which show that we are now in a position to

* Geol. Mag., N.S., Dec. III., vol. i., 1884, p. 385.

do something towards a better understanding of the deposits. That there are different horizons is what we should expect to find, and though lithological and bathymetrical conditions will constantly have to be kept in view as affording some explanation of differences in the faunas of different localities, still to ascribe everything to this and to "colonies," is surely asking more than is likely to be granted. An examination of the published lists of fossils from the lower beds of Muddy Creek,* Mornington, Gellibrand, and Camperdown,† Lower Moorabool Valley (Fyansford, etc.),‡ Belmont and Curlewis,§ Bairnsdale,‖ will show that these beds are on much the same horizon, though the exact relationships are not yet definitely fixed. No lists have been published for Corio Bay, Altona Bay, Newport, or Murgheboluc, but our knowledge of the desposits enables us to refer them to the same series, as the number of fossils at present known to us from these localities is as follows :—

| | | | |
|---|---|---|---|
| Corio Bay | ... | ... | 150 species. |
| Altona Bay | ... | ... | 70 ,, |
| Newport | ... | ... | 115 ,, |
| Murgheboluc | ... | ... | 102 ,, |

From Shelford we have over one hundred and fifty species, gathered by Messrs. Donald Clark, Betheras, and Alex. Purnell, which show that this deposit also may be referred to the same group.

We have shown that the clays at Curlewis¶ overlie a polyzoal limestone similar, lithologically, to that of Maude, and the same is the case at Batesford.♥ With regard to the latter place, it may be mentioned as a further confirmation of our previous reading of the section, that the work carried on at the "Filter Quarries" has displayed a face showing the limestone capped by about ten feet of eocene clay, rich in fossils, together with a thin clay band

* Trans. Roy. Soc. S. Aust., 1888, pp. 40-52.

† *Id.*, 1893, pp. 218-26.

‡ Proc. Roy. Soc. Vic., 1891, pp. 18-26.

§ *Id.*, 1893, pp. 10-13.

‖ Proc. Roy. Soc. Vic., 1890, p. 67. For most of these localities see also "Remarks on the Tertiaries of Australia; together with Catalogue of Fossils" —South Australian School of Mines and Industries, Adelaide, 1892.

¶ Proc. Roy. Soc. Vic., 1893, p. 3.

♥ *Id.*, 1891, p. 11.

intercalated with the upper part of the limestone. This clay is remarkable, chiefly for the great preponderance of trochiform shells, but otherwise resembles the section described by us on the other side of the valley.

There is little doubt that the polyzoal limestones of Waurn Ponds, Maude, Curlewis, and Batesford, are on the same horizon, though slight differences in the faunas certainly exist.

At Flinders and at Airey's Inlet,* at Curlewis and at Maude, a polyzoal rock rests on the older basalt. This in its turn, at Maude, overlies a sandy limestone containing a fauna which is the equivalent of that of Spring Creek. At Waurn Ponds the limestone overlies a clay in which fossils have not as yet been found, but which Mr. Wm. Nelson states† to closely resemble that of Spring Creek.

The Waurn Ponds rock can be traced almost uninterruptedly from M'Cann's quarries, which is the best known exposure, as far as a quarry on the south side of the Barwon River opposite the end of Pakington Street, Geelong. The locality of this quarry we shall indicate by the name of North Belmont. The rock here is a sandy limestone, and the fauna shows a stronger relationship to that of Spring Creek on account of the greater number of mollusca which it contains; though, unfortunately, most occur merely as casts. The dip of the beds is well pronounced being E. 40° S. at 10° This would carry them below the Belmont clays shown in the oft quoted well,‡ and Mr. J. Mulder informs us that limestone was struck at the bottom of the shaft after passing through the clay beds.

The polyzoal rock then appears to be antecedent to the clays of the Lower Muddy Creek type, and to overlie beds with a fauna similar to that of Spring Creek.

It will be seen that we almost entirely reverse the sequence as interpreted by Professor Sir Fredk. McCoy, and adopted by the Geological Survey. According to this view the clays of Mornington, Southern Moorabool Valley (Fyansford, etc.), and

* Proc. Roy. Soc. Vic., 1893, p. 18; Trans. Roy. Soc. S.A., 1893, p. 212; Krausé, First Prog. Rep. Geol. Surv. Vic., 1874, Section IV.

† Proc. Geol. Soc. Aust., vol. i., pt. i., p. 19, 1886.

‡ Proc. Roy. Soc. Vic., 1893, p. 16; and Prof. Tate, Trans. Roy. Soc. S. Aust., 1893, pp. 216, etc.

the Gellibrand River, are the the lowest members of the tertiary group occurring in Victoria, and are referable to the oligocene period, while the beds at Spring Creek are divided into upper, middle, and lower miocene. Selwyn states* that the older volcanic rock marks the close of the miocene period. These views are adopted by Mr. R. A. F. Murray in his work on the Geology of Victoria.

Professor Ralph Tate and Mr. J. Dennant in their paper on the Correlation of the Marine Tertiaries of Australia,† do not attempt any subdivision of the eocene beds, but state that by Professor McCoy the deposit at Mornington "is correctly placed at the base of the tertiary series,"‡ though, whether they intended to imply that it is the oldest of our eocene beds is not clear. Of the older basalt it is said that it may "ultimately prove to be cretaceous,"§ while more recently Professor Tate, as above indicated, refers it to pre-eocene age. Below this series of rocks we have, as shown by Selwyn,‖ at any rate one set of leaf-beds, namely those occurring below the older basalt. Whether these beds are still to be retained in the tertiary period, or are to be referred to cretaceous times is, as we have previously shown, still an open question.¶

## SUMMARY.

Judging by the percentage of recent species of mollusca occurring in the various deposits, we should expect those of the Spring Creek type to underlie the clays of the Lower Muddy Creek type, and the detailed stratigraphical evidence that we have brought forward points in the same direction. We are then, on these grounds, justified in arranging the eocene rocks of Victoria, in so far as they have been critically examined, in the following order, beginning with the highest beds.

1. Clays of the Lower Muddy Creek Type.—Occurring at Muddy Creek, Mornington, Belmont, Curlewis, Lake

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* Exhibition Essays, 1866-67, p. 29.
† Trans. Roy. Soc. South Australia, 1893.
‡ *Loc. cit.*, p. 216.
§ *Loc. cit.*, p. 212.
‖ Exhibition Essays, p. 21.
¶ Aust. Ass. Adv. Science, Adelaide, 1893, p. 338.

Connewarre (Campbell's Point, etc.), Southern Moorabool Valley (Fyansford, etc.), Corio Bay, Altona Bay (bore), Newport (shaft), Gellibrand, Camperdown (Gnotuk), Murgheboluc, Shelford, Bairnsdale (Mitchell River).

2. POLYZOAL LIMESTONE OF THE WAURN PONDS TYPE.—Occuring at Waurn Ponds, Batesford, Maude, Curlewis, Flinders, ? Airey's Inlet, ? Muddy Creek.

3. OLDER VOLCANIC ROCK.

4. CLAYS AND LIMESTONES OF SPRING CREEK.—Maude and (?) North Belmont.

## ART. XVIII.—*On a Molluscan Genus new to, and another forgotten from, Australia.*

(Plate XI.)

By C. HEDLEY, of the Australian Museum, Sydney.

(Communicated by G. B. Pritchard).

[Read 13th September, 1894].

The genus *Lucapinella* was described by Pilsbry on p. 195, of vol. xii., of the First Series of the "Manual of Conchology." He placed in it the following species,—*callomarginata*, Carpenter, the type, from California; *æqualis*, Sowerby, from the west coast of South America; *limatula*, Reeve, from the West Indies, and doubtfully, *aculeata*, Reeve, of unknown habitat.

Some Australian species, though not exactly coinciding with the definition drawn up from spirit specimens of *L. callomarginata*, still appear to me to resemble it sufficiently to justify their inclusion in this genus. My attention was first drawn to this subject by an examination of specimens, the property of the Biological Laboratory of the Melbourne University, dredged in Port Phillip by Mr. Bracebridge Wilson, and kindly communicated to me by Mr. G. B. Pritchard. While studying these I captured alive, at low water, under stones, in Long Bay, near Sydney, a half-grown mollusc, which, known to local collectors as *Fissurella nigrita*, Sowerby, and transferred by Pilsbry to his genus *Megatebennus*, proved at a glance to be generically the same as the forms received from Victoria.

Introductory to the study of the dead Victorian specimens I offer the following notes on the Long Bay animal, which I kept alive in a bottle for some days.

### LUCAPINELLA NIGRITA, Sowerby.

(Figs. 1, 2).

Habits active. Foot and mantle rose, papillæ on foot and mantle white, coronal processes white, sole yellow, snout brown, tentacles

and anal tube orange, a few papillæ along the shell black. Foot, when extended, more than twice the length of the shell, bearing numerous papillæ of various sizes, a few along the epipodial furrow becoming larger and tongue-shaped. Tentacles subcylindrical, tips blunt, half as long as the shell, with conspicuous eyes placed on their outer bases. Snout half the length of the tentacles, slightly tapering, mobile, oral orifice longitudinal. Anal tube sometimes exserted a short distance, surrounded by cushion-like papillæ. Mantle roughened externally and denticulated on both margins by numerous small papillæ, outer margin free all round, capable of sheltering the retracted head and falling curtain-wise from the shell's periphery to the foot; inner margin not overlaying the shell, produced into sixteen erect, branched, waving processes which surround the shell like a crown. Viewed from above these coronal processes give the whole animal the general aspect of a sea-anemone; this, my colleague Mr. Waite, has suggested to me, may be a case of protective mimicry.

### Lucapinella pritchardi, new species.

(Figs. 3, 4, 5, 6, 7).

From a shell collected at Flinders, Western Port, Victoria, by Mr. J. H. Gatliff, I derive figures 5 and 6, and the following description.

Shell oblong, twice as long as broad, parallel sided, ends rather abruptly rounded, slightly pinched on either side of the perforation. When standing on a plane surface the posterior end is suddenly and highly, the anterior gradually and slightly elevated; there is also a space in the middle where the edge of the shell does not stand upon the ground. Perforation narrowly oval, a quarter of the shell's length, its anterior end the shell's centre; viewed edgeways the notch is seen to be cut deepest at the hinder end. Surface sculptured by about ninety radiating unequal riblets, broader than their interstices, beaded where cut across by circumferential growth lines, near the margin this sculpture developes into imbricating scales upon the riblets. Colour—pink, obscurely rayed by half a dozen yellow segments. The interior is white, smooth and porcelainous, except at the sharp edge where it is pink and crenelated by the external

riblets; posteriorly the edge is bordered within by a heavy callus, which gradually thins out about the middle of each side; the perforation is also surrounded by a callus. Length 24, breath 12, height 5 mm.

Another and larger specimen from Aldinga Bay is 27 mm. long, and 13 broad.

Of the spirit specimens from Port Philip represented by figures 3 and 4 I observe that the coronal processes number 20, the exposed portion of the tail nearly equals the shell in length, is closely covered with simple and compound tubercles, and deeply, transversely wrinkled; epipodial groove indistinct, but marked by a line of large conical papillæ. From the original of fig. 4, I extracted a radula, fig. 7, composed of a small triangular rachidian, two sloping chisel-shaped laterals, a large outer lateral, whose cusp is shaped like a scythe blade, and armed with an inner tubercle, and two rows of pin shaped uncini.

*Habitat.*—Flinders (Gatliff) and Port Philip (Wilson), Victoria. Aldinga Bay, St. Vincent's Gulf, South Australia (Pritchard).

*Type.*—The original of Fig. 3, in the Biological Laboratory of the Melbourne University.

I have much pleasure in associating this interesting animal with the name of my friend, Mr. G. B. Pritchard.

### SCYLLÆA PELAGICA, Linne.

A specimen collected by Mr. J. B. Wilson, in Port Philip, and forwarded from the Biological Laboratory of the Melbourne University, by Mr. Pritchard, accords with the figures and description of this species given by Dr. Collingwood in the Trans. Linn. Soc., Zool., Second Series, ii., pp. 137-8, pl. x., ff. 29-33. Much uncertainty envelopes the species assigned to *Scyllæa.* Bergh writes: "Several species have been described, or at least named, some of which will no doubt eventually prove to belong to one circumæquatorial species." Alder and Hancock say: "The species of this genus have been so imperfectly described that it is not easy to decide on their specific differences." To the former authority we owe the latest list of the species, Zoologischen Jahrbuchern, v., pp. 59-62.

Though apparently unknown to Australian naturalists, and omitted from all papers on Australian Mollusca, especially from

Tate's Census of the Molluscan Fauna of Australia, Trans. Roy. Soc. S.A., XI., pp. 70-81, this genus has once before been reported from Australian Seas. Cuvier, in the "Annales du Museum d'histoire naturelle" vol. vi., p. 424, states, "We may add that the companions of Baudin saw it (*i.e.*, *S. pelagica*) near the Terre d'Edels, on the south-west coast of New Holland:" Terre d'Edels was a name given to the coast of Western Australia, between Swan River and Shark Bay. It is described in Freycinet's "Voyage aux Terres Australes," pp. 169-185.

## EXPLANATION OF PLATE.

Fig. 1.—Enlarged outline sketch of *L. nigrita* alive and gliding, viewed from the side.

Fig. 2.—The same viewed from beneath, showing the head withdrawn under the mantle.

Fig. 3.—Type of *L. Pritchardi*, from the side, natural size.

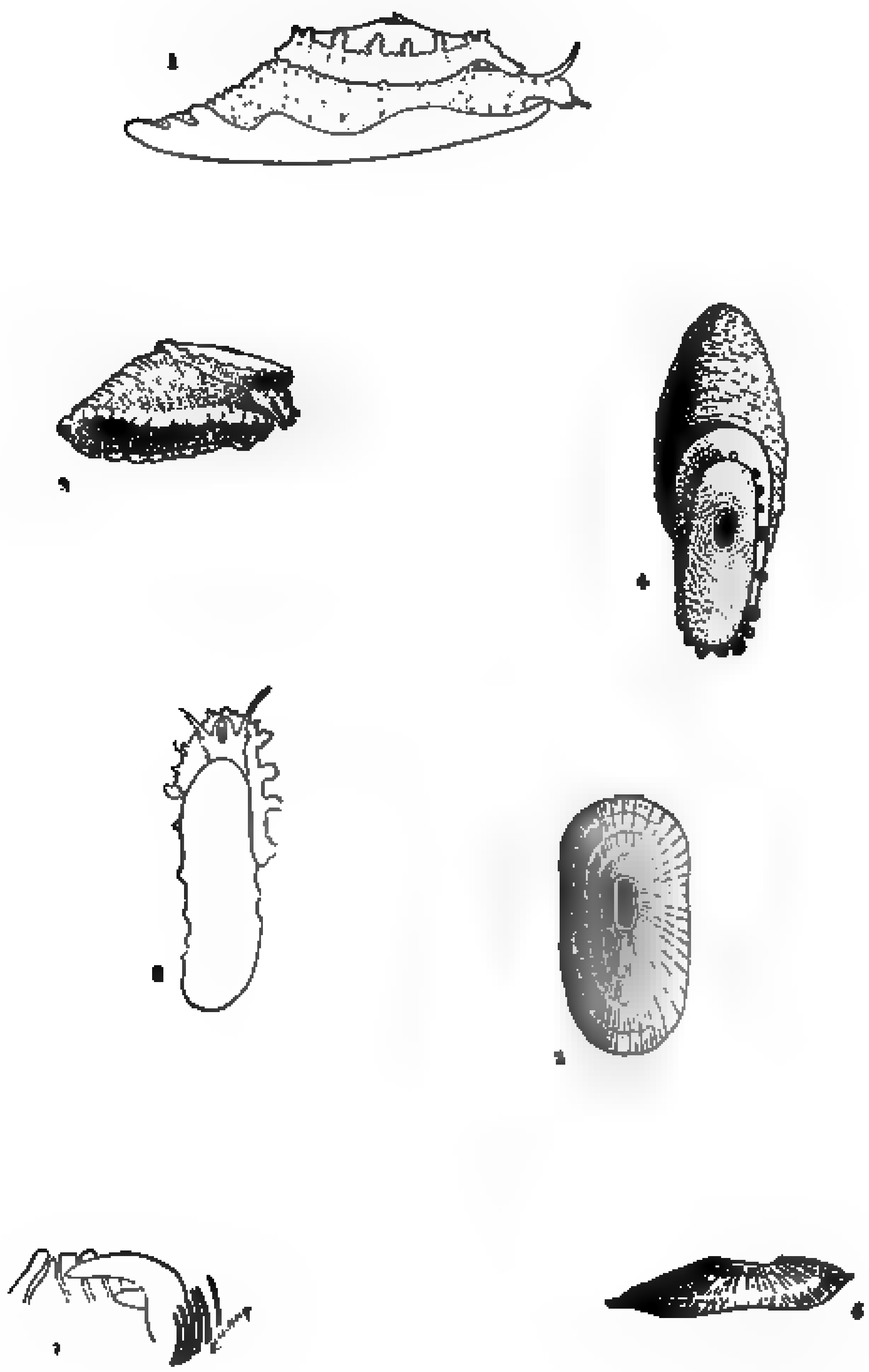
Fig. 4.—Another specimen of the same from above, natural size.

Fig. 5.—Shell of a third specimen of the same from above, natural size.

Fig. 6.—Shell of a third specimen of the same from the side, natural size.

Fig. 7.—Radula of *L. Pritchardi*, magnified.

All figures drawn from life by the writer.



## ART. XIX.—*Notes on Birds.*

By A. J. CAMPBELL.

[Read 8th November, 1894.]

### (1) THE OCCURRENCE OF THE SANDERLING *(Calidris arenaria)* IN AUSTRALIA.

Professor Alfred Newton has recorded the following note in the "Records of the Australian Museum" (1892):—"Having lately occasion to investigate the range of the Sanderling *(Calidris arenaria)*, I came across a memorandum made in the year 1860, of my having then seen in the Derby Museum at Liverpool two specimens of the larger race of this species, one in winter dress and the other in incipient spring plumage, both being marked as females, and as having been obtained at Sandy Cove, in New South Wales, 20th April, 1844, by the late John Macgillivray."

I now record a second occurrence in Australia of this extremely interesting wanderer, but in this instance on the west coast, near the North-west Cape. Mr. Tom Carter kindly forwarded a skin to me with the following memorandum:—"I was out with my gun last week (middle of July, 1894), and after a shot at a party of waders I picked up eight Turnstones, two Little Sandpipers *(Tringa ruficollis, ?)*, and two birds as per skin herewith. I take it to be the Sanderling. You will observe there is no hind toe. The other bird was too much smashed to make a skin."

The skin received I passed on to Colonel Legge, who is much interested in the distribution of our *Limicolæ*. He replies, "*Calidris arenaria* in abraded plumage with new winter feathers coming on back and wings."

### (2) THE OCCURRENCE OF THE EGG OF THE PALLID CUCKOO *(Cuculus pallidus)* IN THE NEST OF THE MAGPIE LARK *(Grallina picata)*.

My friend, Master John Summers, of Cheltenham, presented me with a nest taken in the locality on the 24th September, 1894, containing a set of five eggs of the Grallina, together with the egg of the Pallid Cuckoo *(C. pallidus)*. This is the first instance I am aware of an egg of this Cuckoo having been found in the nest of a Grallina.

# Art. XX.—*The Gymnorhinæ or Australian Magpies, with a description of a New Species.*

By A. J. Campbell.

[Read 8th November, 1894.]

We possess little information about these familiar and favourite birds, and much remains to be learnt respecting them, while it is a matter of surprise that even the knowledge of the geographical range of the various species is so meagre.

The Magpies in their attractive garbs of black and white are indeed emblematical of Australians. They thrive and adapt themselves to almost any part of the continent, are strikingly showy in matter of dress, musical, apt to talk, and if my Australian brethren will permit me to say so, are at times somewhat pert.

It is generally accepted that there are three species or varieties of the genus *Gymnorhina* or so called in vernacular terms—Magpies, and I hope before I finish this article to prove the existence of a fourth, which seems to have been overlooked by previous collectors. Nothing is more delightful than the study of these handsome birds in the open where I have observed the four species. I regret now, as we so often do afterwards, that I did not pay more attention to them when I enjoyed the opportunity.

### *G. tibicen*, Latham (The Black-backed Magpie).

I think we shall find this species ranges from the Gulf of Carpentaria district down through the interior parts of Queensland, New South Wales, and Victoria to South Australia—the focus of numbers being probably in South Queensland, New South Wales, and the Lower Murray district. At early dawn the beautiful piping notes of this Magpie may be heard arising from various belts of timber, but the majority of the birds seldom leave their roost till about sunrise, when they depart singly, in pairs or small companies, to feed upon the plains or other open

ground. They revisit the timber during the day, but towards evening may again be seen on the ground before the various lots hurry in to retire for the night at sundown. At such a time their evensong seems if possible more cheerful. Perhaps five or seven birds will form themselves into the approved art pyramid upon the dead top branches of a gum tree—one bird starts to carol, others chime in, and all conclude in a most joyful chorus as of thankfulness to the departing day.

After the breeding season, and during the winter months, the Magpies congregate in some localities in considerable numbers. This I have more particularly observed in connection with the next species, the White-backed Magpie. Gould says it would appear that the young keep in the company of their parents for the first ten months—that would be till the following pairing season. The pairing season will be found to commence in July, some of the earlier birds laying in August, but the majority lay in September, and the breeding season generally may be said to extend to the end of the year. The nest, which is usually placed in the forked branches of a tree—sometimes a tall, sometimes a low bushy one—is the well known large, open structure built outwardly of dead sticks, twigs and strips of bark, and lined securely inside with a ply of fine bark, grass, hair, feathers, etc. A nest I observed lately on a fringe of Mallee was decorated with numerous long emu feathers artistically interwoven round the rim. The dimensions of the nest, exteriorly, were 33 cm. (13 inches) across by $20\frac{1}{4}$ cm. (8 inches) deep, the inside measurement being $12\frac{3}{4}$ cm. (5 inches) in diameter by 9 cm. ($3\frac{1}{2}$ inches) deep.

The eggs vary in numbers from three to five, a quartette however being most frequently the complement. There is also considerable difference in the character and colour of the markings of the various clutches, so much so, that it is hard to understand why eggs so totally distinct should be laid by birds of the same species, and that frequently in the same locality. Another "nut" for the theorists on egg-colouration to crack.

As giving an insight into the habits of the Black-backed Magpie I may relate the history of a pair I saw in Riverina lately, breeding close to the homestead at Dunvegan, near Deniliquin. An exceedingly handsome male bird was taken when

young from the bush, reared and allowed his freedom about the place. When he was about two years old, hen-birds from the bush came and coquetted with "Charlie," as he is called, who appeared to pay little heed to his admirers. At last the seductions of one of the hen-birds proved too great, and the pair commenced to build a nest in the nearest tree, not one hundred yards from the house. Charlie proved an exceedingly devoted husband, feeding his mate upon the nest regularly by conveying food from the kitchen table, the meat block, and in fact from anywhere he could steal it. This recurred for seven seasons, the seventh season's brood, I was a witness to, and saw Charlie procuring meat in the kitchen to feed the young. Once Charlie's wing was clipped, when he was forced to climb the tree instead of using flight. On another occasion he unfortunately lost a leg in a trap. It was almost ludicrous to watch how the poor bird used the stump in climbing to assist to feed his offspring. When a brood (usually four in number) was reared honours seemed to be divided, he brought two about the house, while the wild bird enticed her pair into the bush.

Magpies in their natural state mostly procure their food upon the ground, devouring almost anything that creeps or crawls, including lizards and possibly small snakes. Occasionally they eat grain, berries, and other fruit, but those persons who contend that Magpies are granivorous, need only place a bird in a cage, keep it upon grain diet, and note how soon it will die.

It is well known that Magpies can be taught successfully to imitate the human voice in speech. When they attain this accomplishment they invariably drop their own clear wild notes, giving voice occasionally to a loud half-crowing half-whistle-like sound, which is simply abominable as compared with the delightful flute-like cadenza one hears the bird pour forth when in native freedom.

At Warroo, in South Queensland, my venerable friend, Mr. Hermann Lau, once found a Black-backed Magpie's nest containing two eggs of that bird, in addition to a pair of eggs of the Great Cuckoo or Channel-bill (*Scythrops*). He also noted that on the Darling Downs the Magpie usually reared two broods a season, one in August, another about October.

*G. leuconota*, Gray (The White-backed Magpie).

This showy and splendid species inhabits the coastal regions and more heavily forested parts of New South Wales, Victoria, and South Australia. Whether it extends further west has not been fully determined. In Victoria, south of the Great Dividing Range, the White-backed species is very abundant. It is instructive to observe how that natural barrier divides the two species —the White-backed from the Black-backed variety. During several trips on our main railway line across Victoria, I noted White-backed Magpies very numerous as far as Mount Macedon and Kyneton. Beyond, the numbers seemed to decrease. The first Black-backed birds were seen at Malmsbury and Taradale. The last White-backs were noted beyond Castlemaine at Harcourt and Ravenswood. In the Sandhurst district the tide of Black-blacks had fairly set in, and by the time the plains of the Murray were reached these birds were in great evidence.

As may be expected the natural habits and characteristics of the Black-backed Magpie appear in the White-backed species. However, as Gould experienced, the White-backed birds are more wary and shyer in disposition. To a discriminating ear the delightful clear ringing call is fuller and louder in the White-backed than in the other species. I have endeavoured to class the different notes, of which there appear three kinds at least—the carol or song, a whistle-like call, and a long "squawk"-like note of alarm. The nidification of the White-back likewise resembles that of the other. A nest taken in the Upper Werribee district measured 45¾ cm. (18 inches) across, while the inside dimensions were 20¼ cm. (8 inches) across, by 7½ cm. (3 inches) deep. It was constructed as usual of dead twigs, and lined inside with grass principally, casuarina needles and wool. A complement of from three to five eggs is laid. There is in the Adelaide Museum a curious exhibit, a nest of this species outwardly composed of twisted and crooked pieces of sheep fencing wire. This season I saw taken from some Melaleuca scrub near the coast, a nest composed entirely of wire-like roots, and well-fitted inside with string, pieces of jute, etc. The roots were Melaleuca, and had evidently been taken from a newly grubbed piece of ground near.

I possess a note of this species also breeding in semi-captivity, but in this instance the tame bird was the female. She was two years old when she built a nest on a roof of an outbuilding near my uncle's house, Heyfield, Gippsland. A pair of young were hatched. She was a most persistent nuisance when building her nest—pulling fibre out of door mats, unravelling the edges of oilcloth, etc. One day, after a chance haircutting operation, the bird eagerly seized mouthfuls of hair to finally trim her nest. This bird lost its beautiful native carol, adopting instead the voices of various roosters and other farm-yard fowls.

Some birds, especially old ones, grow very savage, and will attack and strike persons approaching the vicinity of their nest. Once I saw a pair enforce the "move-on clause" on a wedge-tailed eagle, which the magpie attacked from above—every thrust making tufts of feathers fly from between the shoulders of the great bird of prey. I heard of a "hen-wife" who kept a couple of tame magpies about the farm because they encouraged wild ones near, which were a safeguard to her chickens and young poultry against certain birds of prey. If a hawk appeared anywhere in the neighbourhood it usually met with a warm reception from the magpies.

*G. dorsalis*, n. sp. (The Long-billed Magpie).

The recorded data regarding the geographical range of the *Gymnorhinæ* on the continent, is somewhat perplexing to ornithological students. Gould states in his "Handbook," "It is true that a bird of this genus inhabits the neighbourhood of Swan River (W.A.), whose size and style of plumage are very similar [to *G. tibicen*], but which I have little doubt will prove to be distinct," and in his tabulated list in the West Australian column has inserted *G. tibicen* with a query against it. Yet, under the heading of *G. leuconota*, he says that bird (*G. leuconota*) is called "Goore-bat" by the aborigines of the low-land districts of *Western Australia!* In Dr. Ramsay's "Tabular List" (1883), *G. tibicen* is indicated in the West Australian division, while in his last list (1888) this author has substituted *G. leuconota* without assigning reason for so doing. However, during my own visit to the Western Territory in 1889, I thought the first point might be easily settled as to which of the two species actually inhabits Western Australia.

But to my surprise, on dissecting birds in the bush and observing others in captivity, I found that the mature male bird possessed a *white* back, while the female's was *black*, besides other minor differences, all pointing to a species distinct from either of the eastern forms. For the new variety I would suggest the specific name *dorsalis*, on account of the differential markings of the backs, and to be known on the vernacular list as the Long-billed Magpie, on account of its longer and narrower bill. Perhaps I should say here that during a recent visit of Colonel Legge to Melbourne, I took the opportunity of bringing under his notice examples of the two eastern birds, together with the western forms, and after examination, and without any hesitancy, he concurred in my deductions.

With regard to the range of the western bird I take it to be fairly distributed as far as South-western Australia is concerned, excepting the heavily forested Karri country between King George's Sound and Cape Leeuwin, where I did not observe a single bird. After getting out of the Karri country I noticed the bird in the neighbourhood of Geographē Bay in the more open Jarrah tracts, and along the coast northward. It is said to be found generally throughout the Jam-wood (a species of *Acacia*) country. I noted it as far south as Cranbrook, on the overland railway, sixty-seven miles from Albany. A few, I am informed, occur on the Upper Murchison and Gascoyne districts, and as far north as the Hammersley Range plateau.

At Geraldton, Champion Bay, I had an opportunity of examining a very fine female bird in a state of domestication. By the way, she rejoiced in the name of "Jacob." She was an intensely amusing bird and full of mischievous glee. I should have mentioned that, although the native notes of the western Magpie resemble those of its eastern congeners, the western type seems to lack that hilarity of song so noticeable in both the eastern birds.

The nest, together with a set of eggs of the western species, has already been described by me in the "Proceedings" of this Society, 1890, but for the sake of comparison I may repeat, the nest was constructed outwardly of sticks and twigs, lined inside with bark, which succeeded a ply about 2½ cm. (1 inch) in thickness of finer bark. Measurements across all about 30 cm. (11¾ inches) inside

dimensions 15 cm. (6 inches) across by about 6½ cm. (2½ inches) deep.

September, October and November constitute the chief breeding months.

*G. hyperleuca*, Gould (The Lesser White-backed Magpie).

Fourthly and lastly, the Tasmanian Magpie is an insular form of the White-backed Magpie of the continent. Considering that the Tasmanian forms of the same species of the mainland birds are usually larger, it is worthy of remark that the Tasmanian Magpie is smaller—an additional fact, perhaps tending to prove it is a good species and not merely a smaller race of *G. leuconota*. Likewise, it is a curious fact that, although some of the birds peculiar to Tasmania—including a *Strepera* closely allied to *Gymnorhina*—are met with on the larger intermediate islands in Bass Straits the Magpie is altogether absent.

Tasmania was the first colony that extended protection to Magpies, as birds of usefulness, consequently, through not been molested, one finds them exceedingly tame, even sometimes building their nests in trees by the wayside of thoroughfares and streets. I was greatly entertained one day by a Magpie, perched upon a three-railed fence, piping its merry song to a railway train which whizzed past within a few paces of the bird.

The Tasmanian Magpie usually lays three or four eggs, but I have heard of sets of five as with the mainland species. The breeding season is from August to the end of the year. Mr. Arthur E. Brent, from his own observation, informs me, that these birds are not at all particular what they use as constructing material for a home. One nest he saw was built of the wire which bound sheaves of grain, and which was thrown in a heap after threshing. Mr. Brent also observed another nest which was constructed of reaper and binder twine. This nest was lined with horse manure. But of course these are merely exceptions, the nest usually resembling those of the other Magpies. Underneath and adjoining a nest of this Magpie I, on one occasion, found the smaller nest of the Yellow-tailed Tit (*Geobasileus*). The fact, however, is not new, for collectors on the mainland have not unfrequently met with similar instances.

## Descriptions of Birds.

### *Gymnorhina tibicen.*

*Adult male.*—Glossy bluish-black, except portions of the underparts and primaries, which are of a more brownish tinge, and except nape and hind neck, upper and under wing coverts, edge of wing, upper and under tail coverts, tail (except a broad terminal band and outer web of either of the outermost feathers) and vent, white. Bill, bluish-white, graduating through blue horn colour into bluish-black at the tip; irides, light hazel; legs, black.

*Adult female.*—Differs in possessing a more brownish tinge throughout the black plumage, and by having the nape and hind neck, and lower back grey instead of white.

*Young.*—Most resemble the female, with the dark portions of the plumage brownish-black.

### *Gymnorhina leuconota.*

*Adult male.*—Black generally, more glossy on some portions, and brownish tinged on other parts, except nape and hind neck, back, upper and under wing coverts, edge of wing, upper and under tail coverts, tail (except the terminal band and outer web of either of the outermost feathers) and vent, white. Bill bluish-white, graduating through bluish-slate into bluish-black at the tip; irides, light hazel; legs, black.

*Adult female.*—Differs in having the black portions of the plumage not so intense in colour, and by having back of neck and back grey; some of the feather shafts, particularly on the back, showing a fine dark stripe.

*Young* (from the nest).—Most resemble the female. In some instances, excepting on the head, the dark portions of the plumage are rusty brown.

"Immature birds, of both sexes, have the whole of the back clouded with grey, and the bill of a less pure ash colour."—(Gould).

### *Gymnorhina dorsalis.*

*Adult male.*—Resembles most the male of *G. leuconota*, but is smaller in size, bill narrower, more curved and longer, edge of wings slightly mottled instead of white, and the black terminal

band of the tail narrower and more concentric in form. Bill, bluish-white graduating through bluish horn colour into bluish-black at the tip; irides, hazel; legs, black.

*Adult female.*—Differs conspicuously in having the back black instead of white; back of neck and lower back being of a mottled appearance where the dark feathers are tipped with white, the mottle at back of neck blending into a white nape; the otherwise black plumage is browner in tone than on the male, especially on the under parts and primaries.

### *Gymnorhina hyperleuca.*

*Adult male.*—Glossy bluish-black or glossy black, except nape, hind neck, back, upper and under wing coverts, upper and under tail coverts, tail (except the terminal band and outer web of either of the outermost feathers) and vent, white; edge of wing, white mottled with black; bill, bluish horn colour graduating into black at the tip; irides, clear or bright hazel; legs, black.

*Adult female.*—Differs in having the hind neck and back grey, and the primaries and terminal band of the tail brownish-black.

### Comparative Dimensions in Inches.

| Species. | Total length. | Culmen. | Wing. | Tail. | Tarsus. |
|---|---|---|---|---|---|
| G. tibicen (male) - | 15·75 | 2 | 10·1 | 6 | 2 |
| (female) - | 15·75 | 1·7 | 9·7 | 6 | 2 |
| G. leuconota (male) - | 17 | 2·18 | 11·5 | 7·25 | 2·5 |
| (female) - | 16·25 | 2.06 | 10·75 | 6 | 2·25 |
| G. dorsalis (male) - | 15·5 | 2·31 | 10·25 | 6·1 | 2·1 |
| (female) - | 16 | 2·18 | 10·5 | 6·25 | 2·2 |
| G. hyperleuca (male) - | 13·5 | 1·75 | 9·4 | 5·5 | 2 |

Mr. Edward Degen, the Pterologist, has most kindly furnished me with the subjoined Comparative Statement, showing the Detailed Colouring of the Bastard Wings and Upper Wing Coverts.

| Names of Species. | Bastard Wing. | Covert Feathers of the Primaries. | Covert Feathers of the Secondaries. |
|---|---|---|---|
| G. tibicen (male) - - | First feather black entirely, 2nd and 3rd white on outer web. | White commences on the 4th feather on outer web. Same on 5th and 6th, extending nearly to the tip. 7th feather and following ones quite white. | First feather pure white. 2nd to 6th white with black at the base of inner web. |
| G. leuconota (male) - | First feather black with trace of white. 2nd and 3rd white. The latter not extending so much as on above. | White commences on the 5th on outer web only. The same arrangement applies to the series as far as the 9th. | Showing black on the base of all feathers, also on tips of inner web. |
| G. dorsalis (male) - | First and 2nd feathers black. 3rd showing white at its base only. | Same as in the above species. The inner webs of the 8th and 9th showing white also. | Inner webs black throughout, differing from both the other species. Outer webs white. |
| G. dorsalis (female) - | First feather same as above. 2nd showing white, also 3rd. | Fifth, 6th and 7th whiter on outer webb, 8th, 9th and 10th white, extending over portion of inner web too. | Same as above. |
| G. hyperleuca (male) - | First and 2nd feathers black. Two-thirds of outer web white on 3rd and 4th. | Outer webs of 5th, 6th, 7th and 8th white, but not reaching to tips of feathers. 9th and 10th (not ascertained, specimens moulting), presumably the same throughout the series. | All white, with the exception of 2nd, 3rd and 4th, where the white does not reach the tip on the inner web, leaving a small black spot. |

## Descriptions of Eggs.

Black-backed Magpie *(G. tibicen)*.—Eggs, although varying in shape, are chiefly of a lengthened form; the texture of the shell is somewhat fine but lustreless. There are many different characteristics of colouring. Three types may be singled out for description: *(a)* Ground colour bluish or French grey, beautifully marbled nearly over the whole surface with streaks, dashes and smudges of pinkish- or brownish-red. In some instances the markings form a confluent patch about the apex. *(b)* Other specimens are more greenish in ground colour, and are clouded or blotched with drab. *(c)* Another set has a greenish ground colour but instead of reddish streaks is moderately marked with large roundish spots and blotches of umber and dull slate, most of the blotches having penumbra-like edges. Faint traces of hair-like lines also appear upon the surface of the shell. A full clutch taken in Riverina measures, in centimetres: (1) 3·65 x 2·65; (2) 3·7 x 2·69; (3) 3·72 x 2·68; (4) 3·65 x 2·76; (5) 3·67 x 2·72. Another set, I took in Queensland, gives: (1) 3·78 x 2·82; (2) 3·9 x 2·8; (3) 3·81 x 2·78.

White-backed Magpie *(G. leuconota)*—Three types of eggs may be again selected as the most common, all somewhat lengthened and elegant in form. *(a)* Ground colour light or pale green, almost hidden with streaky and cloudy markings of pinkish-red. *(b)* In others the markings are drab or brown. *(c)* These examples have a plain grey (sometimes greenish) ground colour, and, like the type "*c*" in *G. tibicen* are moderately, almost sparingly, marked with roundish spots and blotches of umber and dull slate. I possess exceptional examples of a beautiful bluish-green colour devoid of markings save a few indistinct freckles of chestnut. Dimensions, in centimetres, of a clutch of type "*b*": (1) 4·02 x 2·72; (2) 4·0 x 2·65; (3) 3·88 x 2·75. A clutch in type "*c*": (1) 3·97 x 2·86; (2) 3·96 x 2·81; (3) 3·97 x 2·8.

Lesser White-backed Magpie (*G. hyperleuca*).—Eggs lengthened in form, light greenish ground colour mottled and marked all over with umber. Another class of specimens which, however, is not so common, is rounder in form and more of a distinct greenish colour, moderately marked as in type "*c*" of the preceeding species, with roundish blotches of umber. Interspersed are also

a few wavy markings. Dimensions, in centimetres: Clutch—long examples: (1) 3·88 x 2·77; (2) 3·7 x 2·69; (3) 3·45 x 2·5. Two, from a clutch of four—round examples: (1) 3·61 x 2·77; (2) 3·57 x 2·87.

Long-billed Magpie *(G. dorsalis)*—The West Australian eggs exhibit less variety of colouring and more resemble the "*a*" type in both those of *G. tibicen* and *G. leuconota*. The form is long and elegant, ground colour varying from bluish-grey to greenish-grey in tone, beautifully streaked or marbled all over with rich pinkish-brown. The following are the dimensions, in centimetres, of three clutches:—

*a*—(1) 3·96 x 2·8; (2) 3·86 x 2·76; (3) 4·33 x 2·68.
*b*—(1) 4·3 x 2·75; (2) 4·12 x 2·7; (3) 4·19 x 2·68.
*c*—(1) 4·23 x 2·71; (2) 4·02 x 2·7; (3) 3·65 x 2·64.

## Art. XXI.—*Australian Fungi.*

By D. McAlpine, F.C.S.

[Read 8th November, 1894.]

In 1892 a "Handbook of Australian Fungi" was published by Dr. M. C. Cooke, under the authority, and with the assistance, of the several Governments of the Australian colonies. This was a very useful and necessary publication, as it gave workers, or intending workers, in this division of the subject, a substantial basis to start from, and since then various additions have been made. But, as Dr. Cooke points out, the minute fungi requiring a pocket lens for their detection, have been largely over-looked by those collectors who sent home specimens for determination, so much so that, as he states in the introduction, "It is quite probable that in the course of a few years by working up the minute species, the total number contained in this volume would be more than double, even without the investigation of unexplored districts."

It is to these minute species that I am now giving attention, and this first instalment may perhaps encourage other workers in the same field, for truly "the harvest is plenteous, but the labourers are few." I am indebted to several correspondents for a number of the specimens herein described, and they deserve full credit for their praiseworthy labours.

1. Mr. F. Barnard, senior, of Kew, one of the old microscopic workers of the colony, has quite a number of specimens awaiting determination, and as many of them are mounted microscopically, this should facilitate the work.

2. Mr. L. Rodway, of Hobart, Tasmania, who is doing good work among the Phanerogams of that island, has also sent me a number of selected specimens.

3. Mr. G. H. Robinson, of Ardmona, has been most unremitting in his attention to these minute forms. He is a gold medallist of Longerenong Agricultural College as well as a former distinguished student of the School of Horticulture, Burnley, and his trained powers of observation have enabled him to detect many minute

forms of fungi while engaged in his ordinary avocation as a fruit-grower.

The forms recorded are either new to science or to the colonies, or have been found upon new host plants or in fresh localities, and since they are all parasitic fungi, preying upon some form of vegetable life, they are therefore of special interest to the vegetable pathologist.

They are arranged according to the plan laid down in my paper read before the Australasian Association for the Advancement of Science, at Adelaide (1893), on "Botanical Nomenclature, with special reference to Fungi." There are twelve groups altogether, eight of which are represented here. Of the twenty-eight species recorded, eight are new, in addition to one new variety.

## Group III.—Uredines.

### Order Uredinaceæ.

#### (1) *Melampsora Lini*, Tul.

Leaves of *Linum marginale*, Hobart, Tasmania (Rodway, 33).

#### (2) *Puccinia Burchardiae*, Ludw.

*Uredospores.*—Sori amphigenous, bullate, elliptical or sometimes circular, crowded, light brown, erumpent, surrounded at base by dry cuticle of epidermis.

Uredospores globose or oval, yellowish-brown, epispore echinulate, $25 - 28 \cdot 5\mu$ in dia., or $28 \cdot 5 - 31 \cdot 5\mu \times 22 - 25\mu$.

On stem and leaves of *Burchardia umbellata.* October. Cheltenham, near Melbourne, Victoria.

This species was described from South Australia by Professor Dr. F. Ludwig, in "Zeitschrift für Pflanzenkrankheiten," vol. iii., pt. 3, 1893, but no uredospores were found. The above description supplies the omission.

#### (3) *Puccinia Correæ*, McAlp., n. sp.

Hypophyllous. Sori cushion-shaped, circular or interruptedly circular, dirty brown, scattered, soon naked.

Teleutospores yellowish-grey, long stalked, elongated fusoid, constricted at middle; upper cell elongated, tapering and rounded

at apex; lower cell tapering towards base; $44 - 60 \times 17 - 20 \cdot 5\mu$. Pedicel light grey, several times as long as teleutospore.

Mesospores similarly coloured and stalked, ovoid with truncated apex, $25 - 28 \times 16 - 19\mu$.

On under surface of leaves of *Correa Lawrenciana.* Very common on one bush in damp gully, but never found on any other, although plant is common. December. Eastern slope of Mount Wellington, Tasmania (Rodway, 6).

The sori stand out very distinctly from the cinnamon-brown under surface of the leaves, causing corresponding circular depressions on upper surface, of a yellowish-green colour.

### (4) *Puccinia Erechtitis,* McAlp., n. sp.

*Æcidiospores.*—Æcidia on stem and leaves, causing distortion and swelling, pale yellow at first, becoming orange-yellow, arranged close together in lines or irregularly. Pseudoperidia cup-shaped, with white, torn, revolute edges. Æcidiospores variable in shape, irregularly round or oval, orange-yellow, smooth, $19 - 16\mu \times 17 - 12\mu$. Very common all the year round, except during middle of summer.

*Teleutospores.*—Sori for a long time covered by epidermis, black, crowded together and forming a swelling. Teleutospores yellow-brown, pedicellate, elongated, constricted at middle; upper cell dark brown, rounded or pointed and thickened at apex; lower cell usually yellow and tapering towards base, elongated, wedge-shaped, $54 - 57\mu \times 19 - 25\mu$. Pedicels persistent, very pale yellow, to transparent, $38\mu$ long. Found from April to June, but very rare.

On *Erechtites quadridentata?* Ardmona in Goulburn Valley, Victoria (Robinson, 107).

### (5) *Puccinia Hieracii,* Mart.

*Uredospores.*—Sori on upper and less often on under surface of leaves, dark purplish-brown, numerous, scattered, becoming confluent, bullate, surrounded by torn epidermis. Uredospores globose or elliptic, golden-brown, finely echinulate, about $28 \cdot 5\mu$ in dia., or $33 - 27\mu \times 25\mu$.

*Teleutospores.*—Along with uredospores. Sori blackish-brown, usually confluent, on much withered basal leaves. Teleuto-

spores reddish-brown, stalked, elliptic, upper and lower cell about same size; upper cell rounded and not thickened at apex, hemispherical; lower cell somewhat similar, but often tapering towards base, average $38 \times 22\mu$, pedicel transparent, deciduous.

On leaves and flowering stems of *Hypochœris radicata.* All the year round when moisture is present, but especially common about April and May, and September to November. Ardmona, in Goulburn Valley, Victoria (Robinson, 86, 96).

The presence of the fungus seems to check flowering, or at least, to retard development greatly, for healthy plants are met with flowering freely, while diseased specimens are conspicuous by the absence of flowers. The leaves begin by assuming a pale green to yellowish tint, then turn snuff-brown and shrivelled. This form approaches *P. caulincola,* Corda, found by Cooke on *Hypochœris glabra* from Queensland, and which he considers may possibly be a form of *P. Hieracii.*

(6) *Puccinia Hypochaeris,* McAlp., n. sp.

Æcidiospores and Teleutospores occurring together on both surfaces of leaf.

*Æcidiospores.*—Pseudoperidia amphigenous, on greenish-yellow to brownish orbicular patches, clustered, orange-yellow, round to elliptical. Aecidiospores subrotund to oval, pale orange-yellow, $14 - 16\mu \times 12{\cdot}5\mu$.

*Teleutospores.*—Sori intermixed with æcidia, black, elliptical, sometimes run together, girt by ruptured epidermis, sometimes exactly opposite each other on upper and under surface of leaf. Teleutospores chestnut-brown, pedicellate, constricted at middle; upper cell dark brown, rounded or scoop-shaped, thickened at apex; lower cell pale brown, usually tapering towards base; $47 - 50\mu \times 19 - 23\mu$. Pedicels hyaline, sometimes persistent, about length of one of the cells, viz., $24\mu$.

On leaves of *Hypochœris radicata.* October. Ardmona, in Goulburn Valley, Victoria (Robinson, 117).

This species belongs to the group *Pucciniopsis,* Schroet., in which only Æcidiospores and Teleutospores are known, occurring on the same host plant.

(7) *Puccinia Plagianthi*, McAlp., n. sp.

Sori reddish-brown, naked, bullate, scattered. Teleutospores shortly-stalked, yellowish, clavate, slightly constricted in middle; upper cell rounded at apex; lower cell usually tapering towards base, sometimes a counterpart of the upper, similarly coloured; pedicel hyaline, $50 \times 22\mu$.

Very common on leaves and flowers of *Plagianthus sidoides*. August to April. Southern slope of Mount Wellington, Tasmania (Rodway, 11).

(8) *Æcidium eburneum*, McAlp., n. sp.

Æcidia ivory colour becoming brownish, clustered together without definite order. Pseudoperidia cup-shaped, minute, margin finely toothed. Æcidiospores subglobose or elliptical, grey, from 24 to 25 $\mu$ in diameter, or $25 - 28 \times 19 - 22\mu$. On stems, leaves, flower-stalk, calyx and legumes of *Bossiæa cinerea*. October and November. Caulfield and Boxhill, near Melbourne, Victoria (Barnard, 1). Bellerine Swamp, Tasmania (Rodway, 15).

In the Tasmaniam specimens the æcidia are confined to the fruit.

(9) *Æcidium monocystis*, Berk.

On *Abrotanella forsterioides*. Summit of Mount Wellington, Tasmania (Rodway, 30).

(10) *Æcidium Ranunculacearum*, D. C.

On *Ranunculus parviflorus*. Ardmona in Goulburn Valley, Victoria (Robinson, 90).

## Group IV.—Pyrenomycetes.

### ORDER HYPOCREACEÆ.

(11) *Claviceps purpurea*, Tul.

On *Lolium perenne*, *Lolium temulentum*, *Triticum sativum*, etc., Victoria.

### ORDER FOLIICOLACEÆ.

(12) *Sphaerella Fragariæ*, Sacc.

On leaves of strawberry. Victoria, South Australia, and recorded for New South Wales by Dr. Cobb.

This is becoming a very widespread and serious disease of the strawberry plant.

## Group V.—Discomycetes.

### ORDER PHACIDIACEÆ.

(13) *Pseudopeziza Medicaginis*, Sacc.

Sporidia, $9 \times 4{\cdot}5\mu$.

On both surfaces of leaflets of *Medicago sativa.*

Very common nearly all the year round. Ardmona, in Goulburn Valley, Victoria. (Robinson, 90).

## Group VII.—Hyphomycetes.

### ORDER MUCEDINACEÆ.

(14) *Monilia fructigena*, Pers.

On apples, pears, etc. Victoria.

(15) *Oidium Chrysanthemi*, Rabh.

On leaves of chrysanthemum. Victoria.

(16) *Oidium Oxalidis*, McAlp., n. sp.

Broadly effused, greyish, powdery. Hyphæ septate, branched, $4-6\mu$ broad. Conidia oval to barrel-shaped, granular, hyaline $31 \times 12\mu$.

Mostly on upper surface of leaves, sometimes on lower, also on leaf-stalks, stem and fruit of *Oxalis corniculata.* Very common, especially on irrigation patches wherever there is moisture. Ardmona, in Goulburn Valley, Victoria. June to November and right through summer on banks of irrigation channels (Robinson, 103).

### ORDER DEMATIACEÆ.

(17) *Scolecotrichum graminis*, var. Avenæ, Erikss.

On leaves of oats *(Avena sativa).* Victoria.

## Group VIII.—Sphæropsides.

### ORDER SPHÆRIOIDACEÆ.

(18) *Septoria Dianthi*, Desm.

On carnations. September. Near Melbourne, Victoria.

(19) *Septoria Tritici*, Desm.

On fading leaves of wheat, also stem and ear. Victoria, and recorded for New South Wales by Dr. Cobb.

(20) *Phleospora Mori*, Sacc.

On leaves of mulberry. Victoria.

ORDER MELANCONIACEÆ.

(21) *Marsonia deformans*, Cooke and Mass.

On leaves and stipules of cultivated peas. September. South Australia.

GROUP X.—USTILAGINES.

ORDER USTILAGINACEÆ.

(22) *Ustilago Allii*, McAlp., n. sp.

Sori forming minute dark coloured pustules in parallel lines along veins of scale leaves of bulb, at first covered by the epidermis, then pulverulent, black, in streaks or blending into masses.

Resting-spores dark brown, spherical, echinulate, imbedded in gelatinous mass, $4 - 4\frac{1}{2}\mu$. in dia. Jointed mycelium here and there in gelatinous mass, $3\mu$. broad. On scale leaves of stored onion bulbs. Ardmona, in Goulburn Valley, Victoria. (Robinson, 97).

(23) *Ustilago Poarum*, McAlp., n. sp.

Only found on stunted plants so far, distorting, discolouring, and forming black powdery masses, especially on the foliage.

Resting-spores globose or irregularly spherical, yellowish-brown, epispore echinulate, $12\frac{1}{2}\mu$ in dia., or $14 \times 12\frac{1}{2}\mu$.

On very small specimens of *Poa annua*, growing in hard ground. October. Ardmona, in Goulburn Valley, Victoria (Robinson, 82).

(24) *Urocystis occulta*, Preuss.

On wheat plants, very destructive to crop. Victoria; and recorded for New South Wales by Dr. Cobb.

## Group XI.—Phycomycetes.

### ORDER PERONOSPORACEÆ.

(25) *Peronospora parasitica*, De Bary., var. Lepidii, McAlp.

Dense white mould on leaves and other parts of plant, which soon curl, and the fungus forms a felt almost covering the entire surface.

Gonidiophores straight, averaging $6\mu$ thick. Gonidia elliptical, pale grey, $35-41\mu \times 19-22\mu$; membrane about $1\mu$ thick, hyaline, protoplasm granular, with a homogeneous layer between it and membrane, germ-tube issuing laterally.

On leaves, stems and fruit of *Lepidium ruderale*, causing distortion. The lower surface of leaf is attacked first, causing it to curl up. After autumn rains and in spring. Ardmona, in Goulburn Valley, Victoria (Robinson, 108).

The variety principally differs from *P. parasitica* in the stalk of the gonidiophore being straight and not flexuous, and in the shape and size of the gonidia, being sometimes twice as long as broad, and altogether larger.

(26) *Peronospora Schleideni*, Unger.

Common on leaves of onion, shallot, and various species of *Allium*. Victoria.

### ORDER ENTOMOPHTHORACEÆ.

(27) *Empusa Muscæ*, Cohn.

On dead house flies *(Musca domestica)*. Victoria.

## Group XII.—Myxomycetes.

(28) *Plasmodiophora Brassicæ*, Wor.

Causing "club-root" in turnips, cabbages, cauliflower, and other cruciferous plants. Victoria.

## ART. XXII.—*Preliminary Notice of two new Species of Marsupials from Central Australia.*

By BALDWIN SPENCER

(Professor of Biology in the University of Melbourne).

[Read 8th November, 1894.]

The following is a brief description of two new forms of Marsupials obtained in Central Australia during the visit of the Horn Scientific Expedition to the Macdonnell Ranges. The full descriptions, together with illustrations, are reserved for the volume in which it is intended to publish the complete results of the expedition.

(1) *Phascologale macdonnellensis.*

Size medium. Fur somewhat coarse. General colour of back dull greyish-brown with a well-marked chestnut patch behind each ear. Ventral surface grey. The eye is, more or less, surrounded by a light coloured ring, and a light line runs along the upper and under jaws bordering the mouth.

Ears rounded, clothed inside and out with short hairs, reaching when laid forward to about the centre of the eye.

Hands and feet grey. Palms with six striated pads, the proximal half of the pollical pad curved, and with the concavity facing towards the pollex; the proximal outer pad V-shaped, with the apex pointing towards the fingers, the inner leg of the V being slightly longer than the outer.

Soles naked, except under the heel where they are hairy; granulated; hallucal pad divided into two; hallux reaching slightly further than the proximal end of the anterior pads. Pads, six in all, and striated.

Tail shorter than the head and body combined, and notably stout in its proximal half, tapering rapidly about the middle of its length, and from this gradually to the tip. Incrassated. Covered with fairly long stiff hairs. In colour somewhat lighter

than the body, the ventral being slightly lighter than the dorsal surface.

Pouch slightly developed and formed by two lateral folds of skin. Within the pouch area the hairs are comparatively scanty and white in colour; external to the pouch area the hairs are dark coloured for their basal two-thirds the pouch area being thus clearly marked out, and the folds being doubtless more prominent when young are present. Mammæ six (three on each side).

Dentition $i.\ \frac{1.2.3.4}{1.2.3.}.\ c.\ \frac{1}{1}.\ p.\ \frac{1.0.3.4}{1.0.3.4}.\ m.\ \frac{1.2.3.4}{1.2.3.4}.$

Dimensions of Female (in al.).

| | | | |
|---|---|---|---|
| Head and body | ... | ... | 92 mm. |
| Tail ... | ... | ... | 77 ,, |
| Hind foot | ... | ... | 14 ,, |
| Ear ... | ... | ... | 13 ,, |

*Habitat.* — Central Australia (Alice Springs). Terrestrial, living in holes amongst rocks and under stones.

The first specimen was found by Mounted Trooper South, of Alice Springs, and by him presented to Dr. Stirling, for whom it had been intended, who kindly handed it on for description to me as officer in charge of the zoological department of the expedition.

(2) *Sminthopsis psammophilus*, sp. n.

Size medium. Fur close, long, and fine. Dorsal surface dark grey. Ventral surface of head and body white. Brownish tinge on the thighs. Tail with short, stiff whitish hairs dorsally, and black hairs beneath increasing in length dorsally and ventrally at the tip, so as to form a slight crest.

Ears large, reaching half-way between the eye and the pit of the snout; covered back and front with short stiff grey hairs. Palms granulated with six unstriated, and not clearly outlined, pads.

Soles hairy; the hairs covering the surface to the base of the pads, with the exception of a narrow granulated central space, reaching back from the pads to the hallux. Pads, three in

minutely spinulose near the beak. Middle and anterior portion of the valve bearing narrow-rounded undulating transverse ridges; the middle portion or that immediately anterior to the siphonal ridge being crossed by what appear to be impressed lines, number variable, generally about ten, frequently less, radiating from the beak to the ventral margin, shows the ripple-like ridges broken up into quadrangular nodes.

*Dimensions.*—Average of a number of specimens, antero-posterior diameter, 39 mm.; umbo-ventral diameter, 37 mm.; thickness through one valve, 11·5 mm.; thickness of shell, 3 mm. The largest example of the species I have yet seen has the following dimensions, antero-posterior diameter, 55 mm.; umbo-ventral diameter, 49 mm.; thickness of shell, 3·5 mm.

*Locality.*—Abundant in the Lower Eocene calcareous sands, Moorabool Valley, near Maude.

*Observations.*—This species may at first sight be confounded with *T. semiundulata*, McCoy, to which it is closely related, but upon examination may be easily distinguished from Sir F. McCoy's species by its much thicker, more solid, and more regularly convex shell, not so attenuate posteriorly, by the greater angle the posterior margin makes with the hinge line, the absence of flattening of the posterior slope, the straighter ventral margin, the smaller number of posterior radial ribs, and the less crowded transverse ridges. From our other fossil species of this genus, namely, *T. howitti*, McCoy, *T. acuticostata*, McCoy, and *T. tubulifera*, Tate, it is still more readily separable, as the first two have, like the recent species, radial ribbing only, while the third is a minute shell with well developed tubular projections on the transverse ridges as well as on the radial ribs.

The first examples of this species that came under my notice were in the collection of the Rev. A. W. Cresswell, M.A., of Camberwell, who had obtained his specimens from the Maude district. Subsequently I had an opportunity of visiting this district in company with Mr. T. S. Hall, and was able to collect a large series of specimens.

Species name in compliment to Professor Ralph Tate of the Adelaide University.

MYOCHAMA TRAPEZIA, sp. nov.

(Plate XII., figs. 8, 9.)

Shell trapezoidal elongate, moderately thick. Left valve free and very slightly convex, convexity more marked in the neighbourhood of the umbo, umbo sharply pointed and incurved immediately over the well marked triangular cartilage pit, anterior margin straight, dorsal margin straight, making an angle of 110° with the anterior margin and truncated at an angle of 125° posteriorly, anterior and posterior margins slightly rounded to join the convex ventral margin. Ornamented with concentric ridges or corrugations separated by somewhat broader shallow interspaces, a few faint radial wrinkles on the posterior slope. Right valve convex, frequently only partially attached by a limited portion of the dorsal surface, umbo free and ornamented with regular narrow concentric ridges, the concentric corrugations of the unattached ventral portion of this valve generally not so well defined as those of the left valve, faintly radially wrinkled anteriorly and posteriorly.

*Dimensions.*—Average right and left valves antero-posterior diameter, 26 mm.; umbo-ventral diameter, 18 mm.; largest example antero-posterior diameter, 29 mm.; umbo-ventral diameter, 22 mm.

*Locality.*—Eocene blue clays of Curlewis, Bellarine Peninsula. —Six examples. Eocene, lower beds at Muddy Creek, near Hamilton.—One example

*Observations.*—It is only recently that any fossil species of this genus have been recorded from the Victorian Tertiaries. Professor Tate, in a paper* on "Unrecorded Genera of the Older Tertiary Fauna of Australia," describes and figures two new species under this genus, *M. plana* from the Miocene of the Gippsland Lakes, and *M. rugata* from the Eocene of Spring Creek, and of the Gellibrand River. The new species herein described is closest related to *M. plana*, Tate, but differs from it most noticeably in outline, and in the more regular and well-developed concentric ridges, and in the absence of any umbonal radial corrugations. The new species appears to be commonly only partially attached by a limited portion of the dorsal region of the right valve to

* Proc. Roy. Soc. N.S.W., 1893.

minutely spinulose near the beak. Middle and anterior portion of the valve bearing narrow-rounded undulating transverse ridges; the middle portion or that immediately anterior to the siphonal ridge being crossed by what appear to be impressed lines, number variable, generally about ten, frequently less, radiating from the beak to the ventral margin, shows the ripple-like ridges broken up into quadrangular nodes.

*Dimensions.*—Average of a number of specimens, antero-posterior diameter, 39 mm.; umbo-ventral diameter, 37 mm.; thickness through one valve, 11·5 mm.; thickness of shell, 3 mm. The largest example of the species I have yet seen has the following dimensions, antero-posterior diameter, 55 mm.; umbo-ventral diameter, 49 mm.; thickness of shell, 3·5 mm.

*Locality.*—Abundant in the Lower Eocene calcareous sands, Moorabool Valley, near Maude.

*Observations.*—This species may at first sight be confounded with *T. semiundulata*, McCoy, to which it is closely related, but upon examination may be easily distinguished from Sir F. McCoy's species by its much thicker, more solid, and more regularly convex shell, not so attenuate posteriorly, by the greater angle the posterior margin makes with the hinge line, the absence of flattening of the posterior slope, the straighter ventral margin, the smaller number of posterior radial ribs, and the less crowded transverse ridges. From our other fossil species of this genus, namely, *T. howitti*, McCoy, *T. acuticostata*, McCoy, and *T. tubulifera*, Tate, it is still more readily separable, as the first two have, like the recent species, radial ribbing only, while the third is a minute shell with well developed tubular projections on the transverse ridges as well as on the radial ribs.

The first examples of this species that came under my notice were in the collection of the Rev. A. W. Cresswell, M.A., of Camberwell, who had obtained his specimens from the Maude district. Subsequently I had an opportunity of visiting this district in company with Mr. T. S. Hall, and was able to collect a large series of specimens.

Species name in compliment to Professor Ralph Tate of the Adelaide University.

### Myochama trapezia, sp. nov.

(Plate XII., figs. 8, 9.)

Shell trapezoidal elongate, moderately thick. Left valve free and very slightly convex, convexity more marked in the neighbourhood of the umbo, umbo sharply pointed and incurved immediately over the well marked triangular cartilage pit, anterior margin straight, dorsal margin straight, making an angle of 110° with the anterior margin and truncated at an angle of 125° posteriorly, anterior and posterior margins slightly rounded to join the convex ventral margin. Ornamented with concentric ridges or corrugations separated by somewhat broader shallow interspaces, a few faint radial wrinkles on the posterior slope. Right valve convex, frequently only partially attached by a limited portion of the dorsal surface, umbo free and ornamented with regular narrow concentric ridges, the concentric corrugations of the unattached ventral portion of this valve generally not so well defined as those of the left valve, faintly radially wrinkled anteriorly and posteriorly.

*Dimensions.*—Average right and left valves antero-posterior diameter, 26 mm.; umbo-ventral diameter, 18 mm.; largest example antero-posterior diameter, 29 mm.; umbo-ventral diameter, 22 mm.

*Locality.*—Eocene blue clays of Curlewis, Bellarine Peninsula. —Six examples. Eocene, lower beds at Muddy Creek, near Hamilton.—One example

*Observations.*—It is only recently that any fossil species of this genus have been recorded from the Victorian Tertiaries. Professor Tate, in a paper* on "Unrecorded Genera of the Older Tertiary Fauna of Australia," describes and figures two new species under this genus, *M. plana* from the Miocene of the Gippsland Lakes, and *M. rugata* from the Eocene of Spring Creek, and of the Gellibrand River. The new species herein described is closest related to *M. plana*, Tate, but differs from it most noticeably in outline, and in the more regular and well-developed concentric ridges, and in the absence of any umbonal radial corrugations. The new species appears to be commonly only partially attached by a limited portion of the dorsal region of the right valve to

* Proc. Roy. Soc. N.S.W., 1893.

such organisms as polyzoa, and on that account in all the specimens yet to hand the shape is fairly constant; but should wholly attached valves occur, as is not unlikely, the shape would then necessarily be greatly dependent upon the surface of attachment.

### PINNA CORDATA, sp. nov.

(Plate XII, figs. 4, 5.)

Shell thin, triangular, elongate; valves very convex; dorsal half bearing about ten smooth longitudinal ribs increasing in breadth posteriorly, with shallow interspaces which also become broader posteriorly, but much more rapidly than the ribs; dorsal slope abrupt apically, becomes more gradual posteriorly, ultimately similar to the ventral slope; ventral half with numerous close-set concentric lines of growth, and broad well defined undulations parallel to the lines of growth becoming obsolete before reaching the dorsal ribs. In juxtaposition to the well defined dorsal ribs, and on the ventral slope there are four or five very faintly developed close and narrow longitudinal ribs becoming slightly stronger posteriorly. Dorsal margin at first straight, then rapidly ascending, giving it a distinctly concave aspect; ventral margin concave about the byssal orifice, then rapidly ecurved becoming regularly convex to the posterior end; posterior margin incomplete, apparently, from the aspect of the shell, gently rounded from the ventral margin.

*Dimensions.*—Length of dorsal margin (incomplete), 110 mm.; width, 55 mm.; greatest thickness through both valves, 39 mm.

*Locality.*—Eocene sandy limestones, Barwon River, near its junction with the Native Hut Creek. One example collected by Mr. J. Betheras.

*Observations.*—This species seems to be closest related to the South Australian Miocene species, *P. semicostata*, Tate, from the oyster beds of Adelaide and Aldinga Bay, but as far as I have been able to make out from Professor Tate's description and figure, the present species is a relatively narrower and more convex form, with a much more abrupt dorsal slope apically, and is without scales on the longitudinal ribs.

CARDITA MAUDENSIS, sp. nov.

(Plate XII., figs. 6, 7).

Shell thick, rotundate oblong, somewhat depressed; umbo prominent incurved anteriorly; anterior region small, anterior margin gently convexly rounded to join the slightly convex ventral margin; dorsal margin straight, obtusely truncate posteriorly, some examples, particularly young shells, are not so noticeably truncate posteriorly, but appear slightly shorter and have their margins more regularly convexly rounded. Lunule small, depressed, narrow, elongate, cordate. Surface ornamented with nineteen or twenty comparatively broad closely nodulose radiating ribs, separated by narrower shallow concave interspaces, in which the concentric lines of growth are visible. The nodulose ornamentation of the ribs may be truncated spines, as some examples are inclined to be rather spinose anteriorly and posteriorly. Inner margin of the valves coarsely denticulate.

*Dimensions.*—Antero-posterior diameter, 10 mm.; umbo-ventral diameter, 9 mm.; thickness through both valves, 7 mm.

*Locality.*—Lower Eocene calcareous sands, Moorabool Valley near Maude. Fifteen examples.

*Observations.*—This species appears to be somewhat related to *C. delicatula*, Tate, and *C. tasmanica*, Tate, but from the former it differs by not being so abruptly truncate posteriorly, by the umbones not being so anterior, and by the fewer, broader, and much more coarsely ornamented ribs, and from the latter, apart from shape and dimensions, the present species has fewer and broader ribs and much narrower interspaces between the ribs.

CHIONE HALLI, sp. nov.

(Plate XII., figs. 10, 11, 12.)

Shell thin, tranversely oval, moderately convex as a rule, though occasional examples are somewhat depressed; umbo prominent, incurved anteriorly, situate about one-third the length of the shell from the anterior margin; lunule well defined cordate, much raised along the junction of the valves; shell anterior to the beak concave; anterior margin regularly convexedly rounded; post-dorsal margin at first gently sloping from

the beak backwards and downwards, practically straight, then roundly truncate to meet the very slightly convex ventral margin. The usual sized shell is ornamented with from 40 to 50 raised rounded narrow concentric ridges, which become lamellar anteriorly and posteriorly, interspaces very much narrower than the concentric ridges, becoming wider ventrally. The concentric ridges are so close as to prevent any radial ornamentation being seen at first, but, on holding the specimens with a strong light behind them, an exceedingly fine and close radial ribbing is just visible. Interiorly the shell margin is very minutely crenulated.

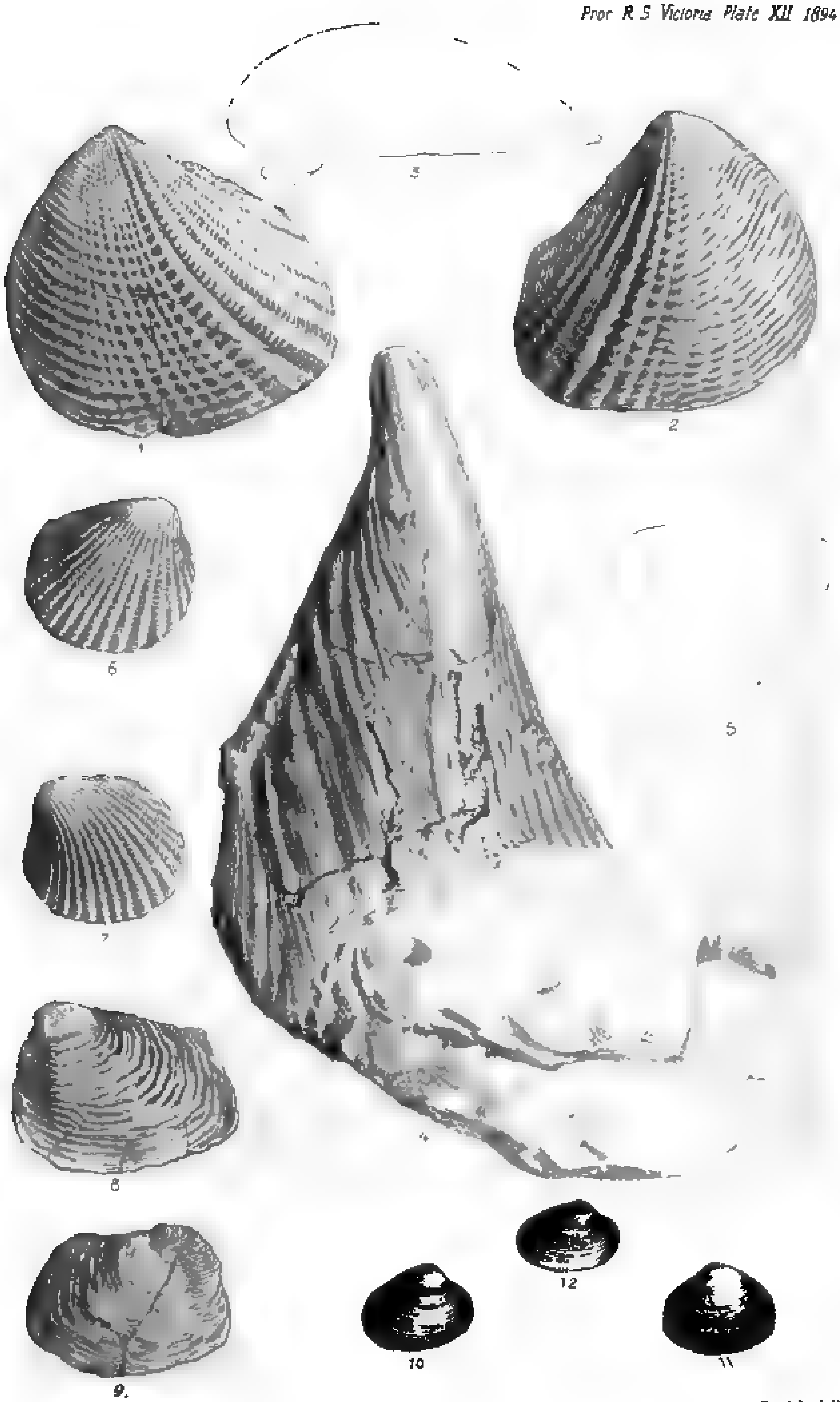
*Dimensions.*—Average specimens give the following measurements, antero-posterior diameter, 11·5 mm.; umbo-ventral diameter, 9 mm.; thickness through both valves, 6 mm. The largest specimen at present in my possession measures along its antero-posterior diameter, 16 mm., and umbo-ventral diameter, 13 mm.

*Locality.*—Common in the Lower Eocene sands and clays of Spring Creek, 14 miles south of Geelong.

*Observations.*—This species is very closely allied to *Chione propinqua*, T. Woods, but is a much smaller shell than the adult of that species; compared with young examples of *C. propinqua* of about the same size from the Miocene beds of Muddy Creek, the new species differs in form, is a thinner shell, is much more convex, the umbones are more prominent, the concentric ridges are finer and more numerous, the radial ribbing is obscure and is not continued on to the concentric ridges or lamellæ. These differences seem adequate to my mind to justify the proposal of a new specific name for this shell, particularly as they appeared very constant throughout my examination of upwards of sixty examples.

I have much pleasure in attaching to this shell the name of my friend, Mr. T. S. Hall, M.A., Demonstrator and Assistant-Lecturer in Biology at the Melbourne University.

In conclusion, I must express my indebtedness to Professor W. Baldwin Spencer, and tender to him my best thanks for photographing these shells for lithographic purposes.




R Wendel lith.

## EXPLANATION OF PLATE.

Fig. 1. Trigonia tatei, sp. nov., left valve, natural size.

Fig. 2. „ „ right valve, natural size.

Fig. 3. „ „ side view of a left valve, natural size.

Fig. 4. Pinna cordata, sp. nov., natural size.

Fig. 5. „ „ outline section at 3·5 cm. from apex.

Fig. 6. Cardita maudensis, sp. nov., right valve, twice natural size.

Fig. 7. Cardita maudensis, left valve, twice natural size.

Fig. 8. Myochama trapezia, sp. nov., left valve, natural size.

Fig. 9. „ „ right valve, natural size.

Fig. 10. Chione halli, sp. nov., right valve, natural size.

Fig. 11. „ „ left valve, natural size.

Fig. 12. „ „ right valve of a somewhat depressed form, natural size.

## ART. XXIV.—*Catalogue of Non-Calcareous Sponges collected by J. Bracebridge Wilson, Esq., M.A., in the neighbourhood of Port Phillip Heads.*

### PART I.

By ARTHUR DENDY, D.Sc.,

Professor of Biology in the Canterbury College, University of New Zealand; Corresponding Member of the Royal Society of Victoria.

[Read 13th December, 1894.]

### INTRODUCTORY REMARKS.

In presenting the first part of this catalogue for publication it seems desirable to offer some prefatory remarks in explanation of the nature of the work. The circumstances under which the examination of Mr. Wilson's sponges was originally undertaken have already been explained in the introduction to the first part of my "Monograph of Victorian Sponges," and the reasons which led to the modification of the plan originally proposed, and to the at any rate temporary abandonment of the monograph as such, have been stated in the introductory remarks to my "Synopsis of the Australian Calcarea Heterocœla." I can hardly say that I regret having been obliged to modify my original plan. In the case of the Homocœla, dealt with in the first part of the monograph, the amount of material to be examined was comparatively small, and there was, consequently, a possibility of some approach to completeness in the first instance. In the other groups, however, the amount of material is so large that it certainly seems desirable to publish a systematic epitome without waiting for the possibility of publishing complete and final descriptions accompanied by the necessary illustrations. The Calcarea Heterocœla have thus already been dealt with, and I now enter upon the task of dealing similarly with the enormous mass of material comprised under the non-calcareous sponges.

The present catalogue makes no pretence to completeness. A very large number of small specimens as yet remain entirely

unexamined, and though the majority of these are doubtless duplicates, yet a certain proportion of new species will probably be found amongst them. The bulk of Mr. Wilson's collection of non-calcareous sponges is contained in upwards of nine hundred large Mason jars, each containing, as a rule, a single specimen, or at any rate so much of a specimen as could be got into the jar. All these have been microscopically examined, and will be included in the present catalogue. The specimens themselves are at present lodged in the Biological School of the Melbourne University.

The production of the catalogue has been unavoidably interfered with by my removal from Melbourne to Christchurch at the commencement of the present year. I wished, if possible, to complete the external examination of the specimens, and the preparation of rough microscopic sections of each before I left Melbourne, so as to avoid the necessity of removing the whole collection to New Zealand. This could not have been done had it not been for the great kindness of my friend, Mr. A. G. Fryett, who most generously offered his assistance, and devoted a month of continuous work to the cutting and mounting of the necessary sections. Meanwhile I drew up short descriptions of the external characters of each specimen and numbered each consecutively as it happened to come in the collection. I was thus able to bring to New Zealand sufficient data for the systematic working out of the collection. Before proceeding with this work, however, it was necessary to make a careful study of the numerous species described by Mr. H. J. Carter, F.R.S., from material sent to England some years ago by Mr. Wilson, and now lodged in the British Museum. Thanks to the kindness of Dr. Günther, F.R.S., keeper of the Zoological Department in the British Museum, I have in my possession fragments of a very large number of Mr. Carter's types, amounting to over 200 specimens of non-calcareous sponges, some dry and some in spirit. Of all these I prepared microscopical sections, and compared them with Mr. Carter's descriptions. I was thus able to gain an extensive personal knowledge of Mr. Carter's species, which will, I hope, add greatly to the value of the present work.

Amongst the collection in Melbourne I find that there are a very large number of duplicates, there being in some cases two or

three dozen jars of the same species. This is due to the fact that the species are very difficult to distinguish by external characters alone, owing to their variability in form and sometimes also in colour. Although the presence of so many duplicates has greatly increased the labour of examination, yet they are very valuable as showing the variation in form and colour. I have been very doubtful as to the advisability of enumerating every specimen in the present catalogue. As, however, they may be distributed amongst museums in various parts of the world and may thus be extremely useful as standards of reference, I have decided to do so.

Each specimen bears my own register number, prefixed by the letters *R.N.*, and quoted in this catalogue. After my own register number I have, except in cases where there are a large number of duplicates, quoted in brackets the particulars as to locality (station number or letter), and natural colour, supplied to me by Mr. Wilson. A number followed by the letter "f" indicates the approximate depth in fathoms.

I have also quoted under each species the specimens by which it is represented in the British Museum, so far as I have knowledge thereof. These specimens are numbered as sent out to me, the numbers being prefixed by the letters *B.M.* The letter "d" before any such number stands for "dry," and "sp." for "spirit." The name attached in the British Museum and the British Museum register number, where known, are quoted in brackets after the number. It is hoped that these precautions will facilitate any future discussion on questions of synonymy, and will indicate the exact nature of the authority on which I have relied.

As regards the exact locality in which the specimens were collected, I may mention that Mr. Wilson has arranged a series of dredging "stations" which he designates by means of letters or numbers. The letter "x" indicates a station outside but near Port Phillip Heads. A number prefixed simply by the letter "s" indicates a dredging station inside the Heads. I hope that Mr. Wilson may soon publish a list of these stations for convenience of reference.*

* See Article XXV., in which Mr. Wilson has published the list of stations referred to.

As regards the notes on the colours of the living sponges supplied by Mr. Wilson, and forming a most valuable contribution to our knowledge of the group, I may remark that a large number of them are based upon a comparison of the specimens with the plates in Ridgway's "Nomenclature of Colors for Naturalists" (Boston, 1886), and that in these cases I have made use of the nomenclature of that author.

The present instalment, forming Part I. of the catalogue, includes only the Families Homorrhaphidæ and Heterorrhaphidæ of the Order Monaxonida. Although I am aware that considerable modification will doubtless have to be made in the classification of the Monaxonida as proposed by Mr. Ridley and myself in our "Challenger" Report, and that much valuable work in this direction has of late years been accomplished, especially by Mr. Topsent, yet I have decided to adhere for the present to our original scheme. I have done so because the "Challenger" Reports form an accessible and recognised standard of reference, and because the proposed modifications can hardly, in the present state of our knowledge, be considered as final. It may, however, be desirable to incorporate some minor and undoubted improvements at once, and in order to facilitate the work of the student I give diagnoses of the families, sub-families and genera as here employed. The spicular terminology is that of the "Challenger" Report on the Monaxonida.

The proportion of new species is, as might be expected from the extent of the collection, large. Thus, in the present contribution, out of a total of thirty-seven species seventeen are described as new.

The abbreviations made use of in the literature references will, I hope, explain themselves. The most frequent is "A.M.N.H.," which of course stands for "Annals and Magazine of Natural History."

## Order MONAXONIDA.

Siliceous sponges with uniaxial megascleres.

### Family HOMORRHAPHIDÆ.

Megascleres all diactinal, either oxea or strongyla; no microscleres.

Sub-family RENIERINÆ.

The spicules may be united together by a small proportion of horny matter, but are never completely enveloped in it.

Genus *Reniera* (Nardo).

Skeleton a close-meshed network of typically single spicules united together by their ends only. The spicules are short oxea or strongyla, whose length forms the width of the skeletal mesh, which may be rectangular, triangular or polygonal. Multispicular primary lines of spicules are often developed.

*Reniera massalis*, Carter, sp.

*Thalysias massalis*, Carter, A.M.N.H., January, 1886, p. 50.

This is a massive, compact, but rather friable sponge, with usually fair-sized and prominent vents. The skeleton is a moderately regular network of small oxea, arranged in slender multispiculary primary and unispicular secondary lines. The colour is pale yellow in spirit.

*R.N.* 349 (19 f; dirty white below, maroon-brown above); 429 (x, 19 f; coral red washed over raw sienna); 815; 1036 (x B).

*B.M.* d. 105 ("*Thalysias massalis*," Reg. 86-12-15-433).

*Reniera brassicata*, Carter, sp.

*Phakellia brassicata*, Carter, A.M.N.H., November, 1885, p. 363.

*Reniera vasiformis*, Carter, A.M.N.H., December, 1886, p. 445.

The sponge is stipitate, with vase-shaped head, which may be proliferous, the lamella being thin, or it may be simply flabellate. The rather stout and somewhat plumose primary lines of the skeleton are suggestive of an Axinellid affinity, the secondary lines are frequently unispicular and very irregular. I have only been able to examine Mr. Carter's "*Reniera vasiformis*," but his description leaves little doubt of the identity of this sponge with his "*Phakellia brassicata*." The oxea are of moderate size, rather stout, curved, fusiform and usually sharply pointed.

*R.N.* 187; 393; 533 (x, 19 f; "cadmium yellow"); ? 1099.

*B.M.* d. 101 ("*Reniera vasiformis*," Reg. 86-12-15-364).

*Reniera clathrata*, n. sp.

Sponge massive, spreading, irregular, somewhat clathrous and throwing off short, irregular, slender, anastomosing branches. Vents variable in size, mostly on monticular projections, either on the main body or on the branches. Texture soft, resilient, rather cavernous; very tender and friable. Light brownish-yellow in spirit.

*Skeleton*, a close network of small oxea, with small polygonal meshes commonly bounded by single spicules; loose multispicular primary lines may be distinguished in parts.

*Spicules*, short, fairly stout, fairly gradually sharp-pointed, slightly curved oxea, measuring about 0·083 by 0·005 mm.

This species may possibly be identical with some of the many British species described by Bowerbank under the name *Isodictya*, but I am not at present in a position to decide this question.

*R.N.* 920 (s.10); 1185.

*Reniera longimanus*, n. sp.

? *Chalina polychotoma*, pars., Coll. Brit. Mus.

Sponge compressed, thin, palmodigitate. Branches long, slender, compressed in the same plane. Vents minute, numerous, arranged in marginal rows. Surface smooth but minutely granular. Texture compact, firm, resilient, but easily breaking. Pale yellow in spirit.

*Skeleton*, a close, irregular network of small oxeote spicules, with multispicular primary and mostly unispicular secondary lines, but often very confused.

*Spicules*, short, slightly curved, fairly gradually sharp-pointed oxea, measuring about 0·083 by 0·005 mm. Except as regards the very characteristic external form this species closely resembles *R. clathrata*.

*R.N.* 576 (x, 19 f; "cream buff"); 609 (x, 20 f; "cream buff.")

? *B.M.* d. 68 ("*Chalina polychotoma*," Reg. 86-12-15-172).

*Reniera proxima*, n. sp.

Flabellate to palmo-digitate with short stout branches; may be stipitate with bushy palmodigitate head. Vents minute, numerous, scattered or marginal. Surface smooth. Texture

compact; but compressible and resilient, and not very tough. Pale yellow in spirit.

*Skeleton*, a close-meshed fairly regular network of small stout oxea; with well-marked, parallel, multispicular primary lines, three or four spicules thick, curving upwards and outwards and separated by the length of a spicule; secondary lines irregular, uni- or multispicular, usually joining the primaries at right angles.

*Spicules*, short, rather stout, slightly curved, rather bluntly pointed oxea, measuring about 0·16 by 0·012 mm. (R.N. 594, rather smaller in 1191).

This species is distinguished from *R. longimanus* chiefly by the size of the spicules.

*R.N.* 288 (18 f; "wax yellow"); 594 (x, 19 f; "cadmium yellow"); 1191.

### *Reniera fryetti*, n. sp.

Erect; flabellate, but thick; slightly proliferous. Margin truncated, broad and flattened, covered with a finely porous membrane, beneath which the numerous long, ascending, main exhalant canals terminate. General surface subglabrous, minutely punctate, rather uneven. Texture compressible, resilient, rather soft and friable. Colour in spirit warm dark brown.

*Skeleton*, a close but irregular network of small oxea with meshes about one spicule's length wide; sometimes distinct multispicular primary lines may be distinguished.

*Spicules*, rather slender, slightly curved, fairly gradually sharp-pointed oxea, measuring about 0·12 by 0·005 mm.

This species is a very remarkable one, easily distinguished by the exhalant marginal pore-sieves and by the dark brown colour. I have very great pleasure in dedicating it to my friend, Mr. A. G. Fryett, as a slight recognition of his valuable aid in preparing microscopical preparations of the Victorian sponges.

*R.N.* 1141, 1183.

### Genus *Halichondria*, Fleming.

Skeleton confused, may be fibrous, but never regularly reticulate. Spicules oxea or strongyla, usually long and slender. Spongin scarcely appreciable.

### *Halichondria cancellosa*, Carter, sp.

*Amorphina cancellosa*, Carter, A.M.N.H., January, 1886, p. 50.

I have not met with any example of this species, nor have I been able to examine the original specimen. It seems to be a large, massive *Halichondria.* The dry sponge is light and fragile, with numerous vents scattered over the surface. The spicules are oxea, measuring about 0·3 by 0·0062 mm.

### *Halichondria arenacea*, n. sp.

Massive, solid, with large collared vents on the convex upper surface and wide exhalant canals. Texture hard, friable and incompressible, owing to the immense quantity of coarse sand of which the interior is chiefly made up. The dermal membrane is free from sand in places, and then appears thin, delicate and minutely reticulate. Colour in spirit brown, owing to the sand.

*Skeleton*, consisting chiefly of the coarse sand grains irregularly and closely aggregated. Between the sand grains is a scanty, irregular spicular network, scarcely fibrous and almost Renierine in character.

*Spicules*, slender oxea, gently curved and fairly gradually sharp-pointed; measuring about 0·2 by 0·0045 mm.

*R.N.* 629 (x, 19 f; "lavender-grey").

### *Halichondria (?) nigrocutis*, Carter, sp.

*Amorphina nigrocutis*, Carter, A.M.N.H., January, 1886, p. 50.

This is a massive irregular sponge, of a dark grey colour in spirit, which is due to the deeply pigmented, minutely reticulate dermal membrane. The main skeleton is composed of long, slender oxeote spicules scattered about in the utmost confusion, though sometimes collected into irregular fibrous tracts. There is a well differentiated dermal skeleton, consisting of a dense feltwork of much smaller oxea lying horizontally; it may become reticulate from the abundance of the inhalant pores. Numerous brown pigment cells are scattered throughout the sponge, especially towards the surface. It is difficult to believe that this sponge is not closely related to some of Mr. Carter's species of *Stellettinopsis*, but I can find no stellate microscleres. Sollas has already

suggested* that *Halichondria* may be derived from a *Stellettinopsis*-like ancestor by loss of the asters, and the characters of the present species certainly seem to strengthen this supposition.

*R.N.* 450 (s. 9, 17 f., "blackish slate"); 685 (s. 9); 727 (s. 5).

*B.M.* d. 102 ("*Amorphina nigrocutis*," unregistered).

### Genus *Eumastia*, Schmidt.†

Sponge consisting of a massive body bearing elongated mammiform projections with vents at their apices. Skeleton consisting of long slender oxea, arranged irregularly or in loose fibres.

The genus resembles *Oceanapia* in external appearance, but differs in the large slender oxea, and probably also in the absence of the bast-like subdermal skeleton reticulation.

### *Eumastia schmidtii*, n. sp.

The sponge consists of a hemispherical body, with long and short finger-like processes springing from its upper surface. Numerous minute vents occur at the summits of the larger fistulæ.

*Skeleton*, composed of thickly, but irregularly scattered oxea, sometimes collected into loose whisps and slightly projecting from the surface in loose tufts.

*Spicules*, long slender oxea, slightly curved and gradually sharp-pointed at each end; closely resembling those of a typical *Halichondria*; measuring about 0·4 by 0·008 mm.

*R.N.* 390.

### Sub-family CHALININÆ.

A considerable amount of spongin is present, typically forming a thick sheath completely enveloping the spicules and uniting them into strong fibres. (In many species the spicules become greatly reduced in size and numbers, while the horny matter increases, thus forming a gradual transition to the so-called Horny sponges).

### Genus *Pachychalina*, Schmidt.

External form various, but not tubular. Fibres stout, with spicules numerous and arranged polyserially.

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* Challenger Tetractinellida, p. 208.

† Grundzüge einer Spongien-Fauna des atlantischen Gebietes, p. 42.

*Pachychalina aurantiaca*, Lendenfeld, sp.?

? *Cladochalina aurantiaca*, Lendenfeld, Zoologischer Jahrbücher, vol ii., p. 768 (1887).

Sponge varying in form from compressed lamellar to digitate. Surface smooth, with minutely reticulate dermal membrane. Vents small, numerous; irregularly scattered, marginal or confined to one side. Texture soft, resilient. Colour in spirit pale yellow.

*Skeleton*, rather wide-meshed, with stout main fibres curving outwards from the centre to the surface, and densely packed with numerous small oxea; these are rather sparingly connected by slenderer secondary fibres which run approximately at right angles to them, and are also multispicular. Immense numbers of spicules are also scattered in the soft tissues between the fibres. There is a well-marked dermal skeleton composed chiefly of close-set tufts of spicules arranged perpendicular to the surface and forming a close-meshed polygonal network when viewed from the exterior.

*Spicules*, small, slender oxea; gently curved, and gradually sharp-pointed; measuring about 0·14 by 0·004 mm.

Von Lendenfeld's type is stated to come from Port Phillip, so that in spite of the meagreness of his description the identification seems fairly likely to be correct, although the spicular measurements differ slightly.

*R.N.* 410 (x, 19 f; "ochre yellow"); 753 (s. 5, "ochre buff"); 823 (x).

*Pachychalina claviformis*, Carter, sp.

*Acervochalina claviformis*, Carter, A.M.N.H., November, 1886, p. 376.

I have only seen a fragment of one of Mr. Carter's specimens from the British Museum; the species appears to be rare. It is characterised by its erect, cylindrical or pear-shaped form, with discoid, root-like attachment below. The surface is smooth; the vents numerous and large; the texture very loose and tender. The skeleton is a very sparse and irregular network of ill-defined, slender, partly multispicular and partly unispicular fibres. The spicules are slightly curved, gradually sharp-pointed oxea, measuring about 0·17 by 0·006 mm.

*B.M.* sp. 32 ("*Acervochalina claviformis*" Reg. 86-12-15-50).

*Pachychalina tenella*, Lendenfeld, sp.

*Chalinopora tenella*, Lendenfeld, Zoologischer Jahrbücher, vol. ii., p. 765 (1887).

The sponge is irregularly massive, sessile, with prominent vents and smooth but uneven surface. The texture in spirit is very soft, spongy and tender, and the colour pale yellow.

*Skeleton*, a lax and very irregular network of slender, usually multispicular fibres, with numerous spicules scattered between.

*Spicules*, very slender, slightly curved, gradually sharp-pointed oxea, measuring about 0·1 by 0·0027 mm.

Von Lendenfeld's type also comes from Port Phillip, where the species is common.

*R.N.* 660; 733 (x, B; "cream buff"); 755 (s. 5; "wax yellow"); 756 (s. 5; "wax yellow"); 767 (Sorrento Jetty; "wax yellow"); 774 (Sorrento Jetty; "sponge grey"*); 783 (Sorrento Jetty, "wax yellow").

*Pachychalina bilamellata*, (Lamarck ?) Carter, sp.

*Cavochalina bilamellata*, Carter, A.M.N.H., October, 1885, p. 287.

*Placochalina pedunculata*, Lendenfeld, Cat. Spong. Aust. Mus., p. 90.

This remarkable sponge usually has a very characteristic external appearance, being leathery and thinly flabellate, and often growing out into two wing-like expansions from a common peduncle. The skeleton network is close-meshed, with multi-spicular fibres and many spicules scattered between; the meshes vary from quite irregular in the interior to rectangular towards the surface. The spicules are short oxea, measuring about 0·54 by 0·004 mm.

*R.N.* 741 (x, B; "sponge grey"); 1008 (x B); 1143 (x).

*B.M.* d. 73 ("*Cavochalina bilamellata*," Reg. 86-12-15-186).

Genus *Chalina*, Grant.

Form various, not tubular. Skeleton reticulation rectangular, with much spongin and few spicules.

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* The grey tint is due to the presence of foreign matter in the form of immense numbers of parasitic worms, crustacea, etc.

*Chalina polychotoma*, (Esper ?) Carter.

*Chalina polychotoma* var. *trichotoma*, Carter, A.M.N.H., February, 1885, p. 115.

*Chalina polychotoma* (with varieties *trichotoma*, *compressa*, *oculata*, *robusta*, *angulata*, *moniliformis)*, Carter, A.M.N.H., October, 1885, pp. 284, 285.

This common species appears to be extremely variable. It is usually a large sponge divided into long, slender or robust branches of very varying shape, and bearing small, scattered or serial vents. The texture is compressible and resilient, and the colour in spirit yellow or brown. In life the prevailing colour is also brown. The skeleton is a close, more or less rectangular-meshed network of horny fibre, more or less abundantly cored with small slender oxea, which may also be scattered between the fibres. The spicules vary somewhat in size, but are usually about 0·06 mm. long.

Mr. Carter has distinguished a number of form varieties, but it is very doubtful whether these can be maintained.

As the specimens collected by Mr. Wilson are so numerous I refrain from giving the locality and colour of each individually. Nearly all of which the locality is recorded come from outside the Heads; one, however, is recorded from Station 9, and one from Sorrento Jetty. The recorded colours range from some shade of brown to "cinnamon-rufous" and "heliotrope-purple."

*R.N.* 263; 270; 313; 325; 328; 330; 414; 469; 596; 724; 786; 873; 1016; 1022; 1032; 1040; 1081 (these are all more or less ordinary forms); 523 (compressed and flabellate, with finger-like processes); 639; 640; 669; 1007 (these have the numerous spicules in the primary fibres arranged in a markedly plumose fashion, as in *Axinellidæ*); 1018 (the arrangement of the spicules is very Renieroid, but they are completely imbedded in spongin).

*B.M.* d. 63 ("var. *nigra*" M.S. Reg. 86-12-15-165); d. 64 ("var. *robusta*" Reg. 86-12-15-163); d. 65 ("var. *oculata*" Reg. 86-12-15-154-155); d. 71 ("var. *angulata*" Reg. 86-12-15-168); d. 72 ("var. *compressa*" Reg. 86-12-15-159).

*Chalina viridis*, n. sp.

Sponge composed of slender, irregular, cylindrical or sub-cylindrical branches, with smooth surface and numerous small vents which may be scattered or serial. Texture (in spirit) compressible and resilient. Colour (in spirit) dark brown; when alive dark green.

*Skeleton*, a network of rather slender horny fibres cored with slender oxea, and sometimes with numerous spicules scattered between the fibres in the soft tissue. The entire skeleton is frequently interrupted by the large canals, which give a very characteristic mottled appearance to sections. Between these interruptions the skeleton net is close-meshed. Towards the surface the meshes are sub-rectangular and little more than one spicule's length in width; in the interior of the sponge they are very irregular. The primary fibres at first run longitudinally in the central portion of the sponge, and branching dendritically curve outwards to the surface; they are multispicular and about 0·02 mm. thick. The secondary, connecting fibres are nearly as thick but mostly unispicular.

The dermal skeleton is a close network with polygonal meshes, formed by fibres resembling the secondaries of the main skeleton.

*Spicules*, short, straight (or slightly curved), slender oxea, gradually sharp-pointed at each end; measuring when full sized about 0·058 by 0·0028 mm.

Spirit specimens of this sponge are very insignificant looking, but the dark green colour in life, changing to dark brown in spirit, appears to be characteristic. As regards skeletal characters I do not think that the species could be distinguished from *Chalina polychotoma*, of which perhaps it is only a variety.

*R.N.* 333 (18 f; "dark rifle green"); 572 (x, 19 f; "parrot green"); 744 (x, B; "rifle green").

*Chalina pergamentacea*, Ridley, sp.

*Chalina pergamentacea*, Ridley and Dendy, Challenger Monaxonida, p. 27 (previous references given here).

*Ceraochalina papillata*, Lendenfeld, Zoologischer Jahrbücher, vol. ii., p. 779 (1887).

The sponge is broadly digitate, often compressed, with scattered or serial vents and glabrous or subglabrous dermal membrane. It is very compressible and of a translucent yellow colour in spirit. The horny fibres are stout and well-developed, but the spicules are reduced to hair-like thinness, scattered more or less abundantly in and between the stout fibres. This great reduction of the spicules and the strong development of the spongin form the most characteristic features of the species.

*R.N.* 453 (s. 9, 20 f; "vinaceous cinnamon"); 461 (s. 14, 10 f; "smoke grey"); 657 (x, 20 f; "wood brown with wash of yellow"); 807 (s. 5); 855 (s. 9); 875 (s. 9); 906 (s. 8).

### Genus *Siphonochalina* (Schmidt).

Sponge tubular; tubes smooth, both inside and out, usually narrow, each with a large round opening (pseudosculum or vent) at the summit.

### *Siphonochalina procumbens*, Carter, sp.

*Patuloscula procumbens*, Carter, A.M.N.H., May, 1882, p. 365.

*Patuloscula procumbens*, Carter, A.M.N.H., October, 1885, p. 286.

*Siphonochalina procumbens*, Dendy, Trans. Zool. Soc., vol. xii. p. 355., pl. lviii., fig. 4; pl. lxii., fig. 1.

In my memoir on the "West Indian Chalininæ" (*loc. cit.*) I questioned Mr. Carter's indentification of the Victorian species with his own West Indian *Patuloscula procumbens*. Having carefully reconsidered the question I do not think it desirable to separate the two.

The sponge is composed of a number of short wide tubes fused together laterally, and each bearing a wide vent at the summit. The surface is uneven but smooth; the texture tough and resilient; the colour in spirit pale yellowish-brown. Perhaps the most characteristic feature is afforded by the remarkably short, nearly straight, hastately pointed oxea, measuring about 0·07 by 0·005 mm. Mr. Carter gives the colour in life as "purple-slate."

*R.N.* 1150 (x).

*B.M.* d. 76 ("*Patuloscula procumbens.*" South coast of Australia. Reg. 86-12-15-208).

*Siphonochalina procumbens*, var. *flabelliformis*, Carter. var.

*Patuloscula procumbens*, var. *flabelliformis*, Carter, A.M.N.H., October, 1885, p. 286.

I have only seen a fragment of Mr. Carter's specimen of this variety. He describes the sponge as consisting of greatly elongated tubes united laterally into a fan-shaped form, rising from a single stem. The skeletal differences as compared with the typical form are very slight.

*B.M.* d. 78 ("*Patuloscula procumbens*, var. *flabelliformis*. Reg. 86-12-15-203).

*Siphonochalina bispiculata*, n. sp.

Sponge irregular, sublamellar, low-growing, proliferous; sometimes rising into short, tubular digitations, each with a wide vent at the summit, or the vents may be smaller and marginal. In spirit the texture is compressible and resilient, and the colour pale yellow.

*Skeleton*, an irregular or rectangularly meshed network of stout horny fibre containing few spicules. The primary fibres measure about 0·05 mm. in diameter, and the secondaries little less. The primary fibres contain a few rather long oxea, the secondaries usually contain no spicules at all, or a very few of the short oxea, which sometimes project from them at right angles. A few spicules occur scattered in the soft tissues, and there is a well-developed dermal skeleton composed of radiating tufts of long slender oxea.

*Spicules*, the oxea are of two distinct kinds:—*(a)* long and slender, straight, gradually sharp-pointed, measuring about 0·2 by 0·004 mm.; *(b)* extremely short, relatively stout, hastately spindle-shaped spicules, with sharp points; measuring about 0·035 by 0·004 mm.

The long oxea occur abundantly in the dermal tufts, and scattered through the soft tissues of the interior. The short ones occur sparsely scattered through the soft tissues, and irregularly in, and projecting from, the horny fibres. Intermediate forms occur in the primary fibres.

In external appearance this species resembles *Siphonochalina procumbens*, but its remarkable spiculation separates it from all

other Chalininæ with which I am acquainted. Both specimens contain numerous developing embryos and come from the same station, so that they may possibly be parts of one and the same sponge.

*R.N.* 1055 (x A); 1079 (x A).

## Family HETERORRHAPHIDÆ.

Skeleton reticulate, never plumose. Megascleres of various forms. Microscleres usually present, but never chelæ.

### Genus *Gellius*, Gray.

Sponge without rind or fistulæ. Megascleres all diactinal, oxea or strongyla. Microscleres present in the form of sigmata, toxa or trichodragmata. Very little spongin present, never forming distinct fibres.

#### *Gellius phillipensis*, n. sp.

Massive or encrusting, with smooth but uneven surface and prominent vents. In spirit the texture is spongy, resilient and friable, and the colour white or yellowish.

*Skeleton*, the main skeleton is a close-meshed network of spicules with little or no spongin, the arrangement being between Renieroid and Halichondrioid. The dermal skeleton is a close-meshed reticulation of spicular fibre echinated by abundant tufts of oxea projecting at right angles to the surface.

*Megascleres*, rather slender, slightly curved oxea; usually gradually sharp-pointed and measuring about 0·18 by 0·0055 mm.

*Microscleres*, *(a)* very numerous, very slender sigmata, varying greatly in length, simple and contort. *(b)* trichodragmata; bundles of hair-like spicules varying much in length in different bundles.

In the presence of trichodragmata this species resembles Carter's *Fibularia massa*,* which is a *Gellius* from Nassau.

*R.N.* 334 (7 f; "wax yellow"); 702 (s. 5; "brownish-yellow"); 723 (s. 5); 973 (s. 5); 794 (variety?).

* A.M.N.H., April, 1882, p. 282.

Genus *Gelliodes*, Ridley.

Megascleres diactinal, oxea or strongyla. Microscleres sigmata. With a distinct skeleton fibre containing more or less spongin.

*Gelliodes poculum*, Ridley and Dendy.

*Gelliodes poculum*, Ridley and Dendy, Challenger Monaxonida, p. 48, pl. x.

I refer one of Mr. Wilson's specimens to this species with a little hesitation. The specimen is erect and goblet-shaped, with broad base, and contains much foreign matter. The oxea are a good deal slenderer than in the type, and the whole skeleton is very irregular.

*R.N.* 448 (s. 14; 10 f; "mouse grey").

Genus *Oceanapia*, Norman.

Sponge consisting of a central body with closed or open tubular processes (fistulæ) projecting from it. Megascleres oxea or strongyla. Microscleres in the form of sigmata, or altogether absent. Skeleton usually coarsely spiculo-fibrous; with a bast-like reticulation beneath the dermal membrane.

As suggested in our work on the Challenger Monaxonida, it seems desirable to unite the genera *Oceanapia* and *Rhizochalina* in one, and as Norman's name has precedence it must of course be employed.

*Oceanapia mollis*, n. sp.

Massive, irregular; with numerous large, prominent, collared vents, rising up from the general surface and leading out of great exhalant canals. Surface uneven, sometimes ridged, subglabrous, minutely reticulate, with a few extremely small and insignificant-looking, closed fistulæ, not at all comparing with the oscular projections in size. Texture soft, compressible, resilient, fragile. Colour in spirit pale brownish-yellow.

*Skeleton*, the main skeleton is a loose and almost unispicular reticulation of fairly stout oxea, connected chiefly at their ends by a fair amount of spongin. The dermal skeleton consists of a superficial network of single spicules, more or less crossing one another, and beneath this a thin bast-like layer composed of a wide-meshed network of multispicular but rather slender fibres.

*Megascleres*, fairly stout, slightly curved, gradually sharp-pointed oxea, measuring about 0·2 by 0·0083 mm. In the deeper parts numerous very slender oxea occur between the others, of which they are probably young forms.

*Microscleres*, very numerous, short and very slender, C-shaped sigmata, measuring about 0·016 mm. from bend to bend.

This sponge is especially characterised by the very feeble development of the closed fistulæ, so that it makes a near approach to the genus *Gellius*, in which they are entirely absent. Both specimens were received at the same time, and though in separate jars, they are probably parts of the same individual.

*R.N.* 1167; 1193.

### *Oceanapia imperfecta*, n. sp.

This species is represented in the collection by a squarish chunk evidently cut from the upper part of a large massive specimen. The upper surface is flattened, subglabrous, and very minutely reticulate. It bears numerous very small, thimble-shaped, blind fistulæ, with reticulate walls and only about one-fifth of an inch high. Numerous long canals run up and terminate in these fistulæ. The texture of the whole sponge is very soft, spongy and tender. The colour in spirit is very pale yellow.

*Skeleton*, the main skeleton is a loose network of very distinct spicular fibres, each about 0·055 mm. in diameter, and composed of densely packed spicules with little or no spongin. The dermal skeleton is an irregular, close-meshed, bast-like network of spicule bundles, abundantly echinated by close-set tufts of projecting oxea.

*Megascleres*, long, slender and almost straight oxea, cylindrical and hastately pointed at each end; measuring about 0·25 by 0·006 mm.

I have not been able to find any microscleres.

*R.N.* 1181.

### *Oceanapia phillipensis*, n. sp.

The sponge consists of a massive, sessile, depressed body, coated and charged with foreign matter, and sending up a number of elongated, hollow fistulæ, ranging up to about three inches in

length and one-third of an inch in diameter. These processes may either end blindly and bluntly, or bear small vents at the summit. The body is fairly compact but compressible and rather spongy, and nearly white in spirit.

*Skeleton*, in the interior of the body no fibres appear to be developed, and the skeleton consists of loosely but very thickly scattered spicules. The dermal skeleton of the body is obscured by the foreign matter. In the fistulæ we have the usual bast-like, reticulate dermal skeleton, strongly echinated by projecting tufts of oxea. Beneath this the cavity of the fistula is partly blocked up by an irregular, close-meshed network of very stout spicular fibre. Towards the surface the meshes became very small and sub-rectangular in shape.

*Megascleres*, rather short, slightly curved, hastately sharp-pointed oxea, measuring about 0·12 by 0·005 mm.

I have seen no microscleres.

*R.N.* 321 (18 f; "body pale buff-brown. Projections white"); 1184.

### *Oceanapia cohærens*, Carter, sp.

*Phlœodictyon cohærens*, Carter, A.M.N.H., December, 1886, p. 446.

My personal acquaintance with this species is limited to a piece of the original specimen sent to Mr. Carter. This specimen was a cylindrical fragment made up of some twenty united tubes terminating in as many vents, all lying close together at the truncated end of the sponge. The skeleton is arranged as usual in the genus, with bast-like dermal network, and coarse, stout spicular fibres in the interior. The spicules are curved oxea, abruptly and bluntly pointed, measuring about 0·15 by 0·008 mm.

*B.M.* sp. 34 ("*Phlœodictyon cohærens*," Reg. 87-7-11-13).

## Genus *Chondropsis* (Carter), n. gen.

Skeleton composed largely of sand and other foreign bodies, usually (? always) arranged in distinct fibres or columns. Spicular skeleton greatly reduced. Megascleres diactinal, strongyla or tylota. Microscleres nearly always present in the form of sigmata.

I had intended using von Lendenfeld's name *Sigmatella* for this genus, but found from Scudder's "Nomenclator Zoologicus" that it was already occupied.

The genus is here employed in a somewhat more restricted sense, however, than was intended by von Lendenfeld for *Sigmatella.* That author's diagnoses* make no sharp distinction between Marshall's *Phoriospongia* and his own *Sigmatella.* If, however, we restrict *Phoriospongia* to species with monactinal megascleres, as was done by Marshall, and reserve *Chondropsis* for those with diactinal megascleres, we shall have a very natural distinction. The occasional styli observed by von Lendenfeld in species of his *Sigmatella*, and by Carter in *Chondropsis*, were probably abnormal or accidental; in all cases the diactinal spicules predominate.

Unfortunately, Carter's type species of *Chondropsis (C. arenifera)* is not a good example of the genus, being devoid of the characteristic sigmata. He gives† no diagnosis, however, and terms his group "Chondropsina," which is co-extensive with his one species, "provisional." The genus *Chondropsis* may, therefore, be really considered as a new one, now for the first time defined.

I have very good evidence of an Ectyonine origin for this genus, but have not space to enter into the question here.

*Chondropsis kirkii*, Carter, sp.

*Dysidea kirkii*, Carter, A.M.N.H., March, 1885, p. 216.

(?) *Sigmatella australis*, Lendenfeld, Monograph of Horny Sponges, p. 611.

*Sigmatella corticata*, Lendenfeld, Monograph of Horny Sponges, p. 618.

The sponge is massive, often compressed but thick, sometimes digitate. The vents are usually large and conspicuous. The surface is smooth or minutely conulose and usually finely reticulate. The texture is compressible, and the colour in spirit pale grey.

The main skeleton is a very beautiful, irregular, tracery-like network of very fine-grained sand-fibre. There is a close-meshed dermal network of similar sandy fibre. The spicular elements are greatly reduced, though the megascleres may still be observed in radiating tufts towards the surface.

* Monograph of Horny Sponges, pp. 598, 611.
† A.M.N.H., February, 1886, p. 122.

The megascleres are very slender strongyla, and the microscleres very minute, much curved, simple and contort sigmata, usually extremely abundant.

This is an exceedingly common sponge, there being no less than thirty-nine specimens in Mr. Wilson's collection; the stations recorded being 5, 6, 7, 8, 9, 10, 11, 14, x A, x B, and Sorrento Jetty. The natural colours of eighteen specimens are recorded; most are shades of yellow or orange; three are pink or salmon; a few are grey with violet or purple tints, and one is bright red.

In two of the British Museum specimens I have found abundant rods and sigmata, as described by von Lendenfeld; in the other (d. 2) I have found rods only. In one of Mr. Wilson's later specimens I have also failed to find sigmata (R.N. 1031).

*B.M.* d. 2 ("*Dysidea kirkii*," Reg. 86-12-15-333); d. 5 ("*Dysidea kirkii*, var. *flabelliformis*," Reg. 86-12-15-344); d. 6 ("*Dysidea kirkii*," Reg. 86-12-15-323).

*R.N.* 309; 318; 336; 456; 457; 458; 515; 688; 703; 704; 714; 765; 766; 771; 775; 777; 785; 788; 795; 816; 831; 832; 854; 859; 864; 883; 894; 908; 943; 954; 985; 993; 1030; 1031; 1053; 1059; 1060; 1094; 1198.

### *Chondropsis wilsoni*, n. sp.

Massive, lobose, or irregular; sometimes compressed, but thick. Vents of moderate size, scattered on prominent parts. Surface rugose or warty, but glabrous and with minutely reticulate dermal membrane between the projections. On the prominent parts of the surface small scar-like sandy areas are scattered, but there is no sandy dermal reticulation. Texture tough, very sandy internally but rather soft and compressible. Colour in spirit nearly white.

*Skeleton*, stout columns of comparatively coarse sand, more or less widely separated from one another, run vertically to the surface, where they terminate in the scar-like sandy areas already mentioned. The sand grains are cemented together by spongin, and stout clear horny fibres occasionally run across from one sandy column to another. Between the sandy columns loose whisps of megascleres, often more or less enveloped in spongin, run towards the surface. The only dermal skeleton is formed by the loose tufts in which these whisps terminate.

*Megascleres*, almost straight, very slender strongyla or tylota with irregular heads, measuring about 0·18 by 0·0025 mm.

*Microscleres*, slender C-shaped sigmata of very regular form and bluntly pointed or even slightly swollen at the extremities, measuring about 0·016 mm. from bend to bend. The surface of the spicule may be very finely roughened.

*R.N.* 540 (x, 19 f; "buff"); 613 (s. 5, 7 f; "ochre-yellow"); 658; 735 (x B; "yellowish buff with reddish tips"); 817; 1054 (x A); (? *R.N.* 663; 711).

### *Chondropsis lamella*, Lendenfeld, sp.

*Phoriospongia lamella*, Lendenfeld, Monograph of Horny Sponges, p. 602. Plate 37; figs. 2, 5, 6, 9, 11.

These are compressed, flabellate sponges, with sub-glabrous, sometimes slightly conulose surface, and small, scattered or marginal vents. They are intensely sandy throughout, incompressible and friable. The megascleres are very few slender strongyla; the microscleres are sigmata, characteristically long, slender and much contorted.

*R.N.* 520 (x, 20 f; "ferruginous"); 1019 (x B).

### *Chondropsis chaliniformis*, Lendenfeld, sp.

*Phoriospongia chaliniformis*, Lendenfeld, Monograph of Horny Sponges, p. 600.

The specimens are compressed, flabellate or palmo-digitate, with vents scattered on one side or marginal. The surface is subglabrous with sandy reticulation showing through the thin dermal membrane. Texture slightly compressible, very sandy, friable. Colour in spirit very characteristic, chocolate-brown throughout, the colouring matter pervading all the soft tissues.

The main skeleton is an irregular network of coarse sandy fibre, the sand particles being comparatively large, and the spongin cement very scanty. There is no special dermal skeleton. The spicular elements are very insignificant, and loosely scattered in the soft tissues.

*Megascleres*, very slender, straight or curved strongyla, or tylota with feebly developed heads, measuring about 0·14 by 0·0014 mm.

*Microscleres*, numerous slender, contort sigmata, measuring about 0·03 mm. from bend to bend.

The sandy skeleton appears to be somewhat coarser, and the sigmata decidedly smaller than described by von Lendenfeld, but not sufficiently so to invalidate an identification. The sponge, however, appears to be quite distinct from Carter's "*Dysidea chaliniformis*," with which von Lendenfeld identifies it. My preparation of Carter's specimen from the British Museum shows it to belong to the *Esperellinæ*.

*R.N.* 945 (x A); 1027 (x B); 1044 (x); 1083 (x A).

### *Chondropsis columnifer*, n. sp.

Massive, irregular, solid, heavy, compact. Surface very uneven, beset with short, flattened, rounded or ridge-like prominences, where the sandy columns come to the surface; smooth, glabrous and grey (in spirit) between these projections. Interior densely charged with sand, arranged in very stout radiating columns; soft and gelatinous between.

*Skeleton*, the main skeleton is composed of the very stout columns of sand above-mentioned, in which the sand-grains, though closely aggregated, appear to be scarcely if at all connected by spongin. The few and feebly developed spicules are irregularly scattered or collected into loose whisp-like bundles, especially towards the surface. There is no dermal skeleton.

*Megascleres*, very slender, straight strongyla or tylota, measuring about 0·2 by 0·002 mm.

*Microscleres*, fairly stout, contort, sharp-pointed sigmata, measuring about 0·035 mm. from bend to bend.

*R.N.* 445 (s. 9, 17 f; "gallstone yellow over wood-brown").

### *Chondropsis topsentii*, n. sp.

Massive, irregular, with nearly smooth but slightly conulose or mæandriniform surface. Vents of fair size, scattered. Texture compact, gritty, friable, densely charged with coarse sand. Colour in spirit brown throughout.

*Skeleton*, the main skeleton is composed of flattened columns of rather coarse sand running vertically to the surface. These columns may unite by their edges in a honeycomb fashion, so

that their ends form a polygonal-meshed reticulation beneath the dermal membrane. The meshes of this reticulation are about 1·3 mm. in diameter and the plate-like sandy columns about 0·2 mm. in thickness. Little if any spongin cement is developed. Between the sandy plates in the body of the sponge the foreign bodies are few and small, but in the minutely reticulate, porous dermal membrane numerous small foreign bodies occur scattered irregularly.

*Megascleres*, few, slender strongyla, perhaps sometimes tylota; sparsely scattered through the ground substance and sometimes more abundant in loose tufts at the surface; measuring about 0·14 by 0·002 mm.

I can find no proper microscleres in any of the three specimens.

*R.N.* 487 (s. 10, 8 f; "drab-grey"); 499 (s. 6, 6 f; "clove-brown with a faint wash of green"); 1071 (x A).

*Chondropsis arenifera*, Carter.

*Chondropsis arenifera*, Carter, A.M.N.H., February, 1886, p. 122.

The single entire specimen which I have examined is massive, rounded, and irregular; with smooth, very minutely reticulate and faintly conulose surface, and large, scattered vents. The texture (in spirit) is rather soft and resilient, sandy, and the colour grey throughout.

The main skeleton consists of very loose and irregular sandy fibres (with little or no spongin), running vertically to the surface. The beautifully reticulate, highly porous dermal membrane contains numerous small, scattered foreign bodies, but there is no distinct dermal skeleton.

The proper spicules are slender strongyla or tylota, scattered through the ground substance, and more numerous in loose tufts at the surface. They measure about 0·16 by 0·002 mm. Numerous other spicules occur as foreign bodies. There appear to be no proper microscleres.

Although Carter mentions proper styli as occurring in this species, I cannot find them in the fragment of his specimen sent to me from the British Museum. My own specimen (R.N. 454), agrees exactly with the type in microscopical features, even down to the presence of the Algæ mentioned by Carter.

*R.N.* 454 (s. 9, 20 f; "olive grey.")

*B.M.* sp. 26 ("*Chondropsis arenifera* C. one of types." Reg. 86-12-15-149).

### *Chondropsis carteri*, n. sp.

The single specimen is small, massive, rounded, constricted below and somewhat flattened above. The vents are minute and grouped on the upper part. The surface is smooth but rather uneven, minutely reticulate in patches. The texture in spirit is compact, but rather compressible, resilient, and the colour pale yellowish-grey.

The main skeleton consists of numerous stout sandy tracts or fibres running more or less parallel with one another towards the surface, and varying greatly in thickness and definition. These sandy fibres are accompanied by numerous strongyla, and occasionally connected transversely by loose bands of the same distinctly enveloped in spongin. The strongyla also occur abundantly scattered through the ground substance, and in loose whisp-like tracts running towards the surface. There is a soft dermal cortex, a little more than a millimetre thick, beneath which the sandy fibres cease. This cortex contains numerous, rather regularly disposed, slender, radiating tufts of strongyla, and numerous loosely scattered sand grains.

*Megascleres*, very numerous, straight, slender strongyla, measuring about 0·23 by 0·003 mm.

*Microscleres*, abundant, rather long, hair-like rhaphides; scattered and in loose whisp-like bundles (trichodragmata).

*R.N.* 978 (s. 5.)

### Genus *Rhaphisia*, Topsent.*

Heterorrhaphidæ with oxea for megascleres and only trichodragmata or scattered rhaphides for microscleres.

I accept the genus as proposed by Topsent, but I cannot agree with that author in placing it amongst the *Renierinæ*.

### *Rhaphisia anonyma*, Carter, sp.

*Amorphina anonyma*, Carter, A.M.N.H., January, 1886, p. 49.

Massive, lobose or irregular, often compressed; with usually large vents abundant on prominent parts. The surface is smooth

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* Arch. de Zool. Exp. et Gén. T. x. 1892, p. 20.

but uneven, with minutely reticulate dermal membrane. The texture is soft, compressible, resilient and loose. The colour in spirit is almost white, in life, usually orange.

The skeleton is loosely fibrous, forming a very irregular network, the primary fibres being stouter and better defined than the secondaries. There appears to be little, if any, spongin. At the surface the primary fibres break up into radiating tufts of oxea which support the dermal membrane and give rise to the characteristic dermal reticulation. Numerous spicules are scattered between the ill-defined fibres.

*Megascleres*, slightly curved oxea, rather long and slender and gradually sharp-pointed at each end, measuring about 0·29 by 0·0042 mm.

*Microscleres*, numerous slender, hair-like rhaphides, about 0·18 mm. long; usually scattered separately but occasionally associated in loose whisps or bundles (trichodragmata).

Mr. Carter seems to have rather over-stated the size of the oxea and he has omitted to mention the rhaphides, which are plentiful in his specimens in the British Museum.

The species is very common, there being no less than twenty-four distinct specimens in the collection entrusted to me. The life-colours of thirteen of these are recorded. Orange is the prevailing tint and there are no great deviations from this. The stations from which the species is recorded are 1, 5, 6, 14, x A, x B, x C.

*R.N.* 268; 369; 395; 447; 482; 544; 553; 577; 631; 651; 699; 706; 751; 804; 818; 909; 914; 936; 957; 1066; 1067; 1085; 1110; 348 (var. ?).

*B.M.* sp. 30 ("*Amorphina anonyma*," Reg. 86-12-15-119); d. 104 ("*Amorphina anonyma*," Reg. 86-12-15-390).

## Genus *Tedania*, Gray.

Megascleres of two kinds: (1) Monactinal; smooth styli, forming the main skeleton; (2) Diactinal; tylota, strongyla or tornota, typically dermal. Microscleres always present in the form of hair-like rhaphides.

*Tedania digitata*, Schmidt, sp.

*Reniera digitata*, Schmidt, Spong. Adriat. Meer., p. 75.

*Tedania digitata*, Carter, A.M.N.H., January, 1886, p. 52.

*Tedania digitata*, var. *verrucosa*, Carter, A.M.N.H., January, 1886, p. 53.

*Tedania digitata*, Ridley and Dendy, Challenger Monaxonida, p. 51 (where other references are given).

This widely distibuted species is very common in the neighbourhood of Port Phillip Heads, there being no less than thirty-four separate specimens in the collection. The external form is massive, lobose or digitate; the vents usually conspicuous, small or large; the surface smooth but generally uneven; the texture soft and spongy; the colour in spirit nearly white, and in life orange. In all of the thirty-four specimens the ends of the diactinal megascleres are microspined, a character by which the species is readily distinguished from the following one.

The life-colours of fifteen specimens are recorded, ten of these are stated to be some shade of orange, four are some shade of yellow, and one is "buff-brown with a tinge of flesh-colour," so that the variation is seen to be but slight.

The stations recorded are 1, 3, 5, 6, 8, 9, 10, x A, x C, Sorrento Jetty, Sorrento Reef, Queenscliff Jetty. Nine specimens came from Sorrento Jetty.

*R.N.* 320; 455; 526; 563; 568; 569; 692; 715; 720; 764; 770; 776; 780; 782; 784; 786A; 789; 796; 802; 814; 834; 850; 866; 871; 892; 962; 971; 975; 991; 992; 1069; 1093; 1105; 1106.

*B.M.* d. 109 ("*Tedania digitata*," Reg. 86-12-15-439); d. 110 ("*Tedania digitata*, var. *verrucosa*, Reg. 86-12-15-432).

*Tedania commixta*, Ridley and Dendy.

*Tedania commixta*, Ridley and Dendy, Challenger Monaxonida, p. 52, pl. xxiii., fig. 9.

This species was represented by a single specimen in the Challenger collection, from Bass Straits. Mr. Wilson's collection contains seventeen examples of it. The sponge is massive and usually contains much sand. The colour in life is orange, pink or brown, as shown by Mr. Wilson's records of twelve specimens.

The species is distinguished from *Tedania digitata* by the smooth-ended tylote diactinal megascleres. As *T. digitata* may also contain a good deal of sand I do not think the two species could be distinguished with certainty without microscopical examination. The amount and disposition of the sand in *T. commixta* varies much.

The stations recorded for the species are 6, 9, x A, x B, Sorrento Jetty.

*R.N.* 417; 441; 444; 498; 505; 552; 606; 747; 768; 769; 772; 781; 863; 960; 996; 1062; 1148.

### Genus *Stylotrichophora*, n. gen.

The main skeleton is a network of horny fibre cored with foreign bodies. In addition to this there are smooth monactinal megascleres (styli) and hair-like microscleres (rhaphides).

The genus is perhaps related to Marshall's *Phoriospongia*, but differs in the distinct reticulate horny fibre, and in the presence of rhaphides instead of sigmata for microscleres.

### *Stylotrichophora rubra*, n. sp.

The single specimen is compressed, lobose and little more than half an inch thick. The surface is smooth and even. The vents are very small and chiefly marginal. The texture is fairly compact, resilient. The colour in life was coral red, disappearing in spirit.

*Skeleton*, the main skeleton is an irregular, wide-meshed reticulation of stout horny fibre, everywhere abundantly cored with foreign bodies (broken spicules), but with a layer of more or less clear, transparent spongin outside the core. The primary fibres are about 0·25 mm. thick, sometimes more, and the secondary, connecting fibres a good deal more slender. Between these fibres is a loose but abundant spicular skeleton of slender megascleres, for the most part irregularly scattered, but collected into loose whisp-like fibres towards the surface. These spicular fibres seem to spring from the horny fibres of the main skeleton and break up at the surface into loose tufts of projecting styli whose ends penetrate the dermal reticulation.

The dermal skeleton is a very beautiful, close-meshed reticulation of foreign bodies (broken spicules) held together by spongin. The meshes of this dermal network are nearly circular and about 0·18 mm. in diameter. In some places the foreign bodies form an uninterrupted layer.

*Megascleres*, long, smooth, slender styli, usually slightly curved and finely pointed, measuring about 0·27 by 0·004 mm., but variable and sometimes a good deal longer.

*Microscleres*, very long and slender, hair-like rhaphides, usually collected into long fibrous whisps.

*R.N.* 478 (x, 20 f; "coral red").

## Art. XXV.—*List of Dredging Stations at and near Port Phillip Heads.*

By J. Bracebridge Wilson, M.A., F.L.S.

[Read 13th December, 1894.]

Station I.—Bounded on the E., by a line from the W. Quarantine boundary flagstaff to the Pope's Eye Buoy. On the N., line from Pope's Eye Buoy to Point Lonsdale. On the W., line from Point Nepean to the channel marks on the shore in Lonsdale Bight.

Depth, very variable, 8–9 fathoms, and in parts 15–21 fathoms.

Station II.—Mid channel just inside the Rip at the Heads.

Depth, 18–32 fathoms. Almost impracticable for working owing to the strength of the tides.

Station III.—Lonsdale Bight, inshore of the Upper and Lower Kelp.

Depth, 3–6 fathoms.

Station IV.—S.E. boundary, the same as the N.W. boundary of Station I. N.E. boundary, in line from Pope's Eye Buoy to Lower Queenscliff Lighthouse. S.W. boundary, flagstaff W. of Quarantine Ground in line with the channel marks on shore in Lonsdale Bight.

Depth, 8–15 fathoms.

Station V.—S.W. boundary, Pope's Eye Buoy in line with the Lower Lighthouse. On the E., Pope's Eye Buoy in line with Swanspit light, extending N.E. about to within a quarter of mile of the Royal George Shoal.

Depth, 6–7 fathoms.

Station VI.—The entrance to Symond's Channel from a line between the Pope's Eye Buoy and No. 1 Black Perch Buoy, about one mile and a half up channel.

Depth, 7–9 fathoms.

Station VII.—From the flagstaff at the W. boundary of the Quarantine Ground to Point Franklin, commonly called Quarry Point, along shore from about a quarter to three quarters of a mile out.

Depth, 8–16 fathoms.

Station VIII.—The entrance to the South Channel from a line between No. 1 Perch Buoy on the N. to No. 2 Buoy on the S. of the channel. The E. boundary, a line from Point King to the western end of Mud Island.

Depth, 8–16 fathoms.

Station IX.—The South Channel from the E. boundary of Station VIII. to near the South Channel Fort.

Depth, 9–11 and in one part 20–21 fathoms.

Station X.—Limeburners' Channel in Capel Sound from near the White Buoy off the Sisters to about half-a-mile beyond Canterbury Jetty.

Depth, 6–10 fathoms.

Station XI.—Capel Sound between the White Cliff and the South Channel Pile Light.

Depth, 6–8 fathoms.

Station XII.—The southern part of Dromana Bay. No. 15 Buoy, in line with the South Channel Shore Light.

Depth, 8–10 fathoms.

Station XIII.—Off Mount Martha.

Depth, 10–13 fathoms.

Station XIV.—From the N. entrance of the Pinnace Channel to the E. entrance to Symond's Channel, along the edge of Mud Island Bank.

Depth, 4–8 fathoms.

Station XV.—Prince George Bank, N. of Indented Head.

Depth, 1½–2½ fathoms.

## Outside the Heads.

Station XA.—About 2½–3 miles out from Point Lonsdale, Mount Duneed showing well clear of Barwon Head.

Depth, 17–19 fathoms.

Station XB.—About 5 miles out with the same stream mark.

Depth, 25-31 fathoms.

Station XC.—Off Barwon Head and Ocean Grove, about 6 miles from Point Lonsdale, and 2–3 from shore.

Depth, 19–25 fathoms.

# Art. XXVI.—*Preliminary Notice of certain New Species of Lizards from Central Australia.*

By A. H. S. Lucas, M.A., B.Sc., and C. Frost, F.L.S.

[Read 13th December, 1894.]

The following contains a description of five new species and one new variety of lizards collected in Central Australia during the visit of the Horn Expedition. The full descriptions, accompanied by figures, together with a complete report, will be published in the volume dealing with the work of the Expedition.

## *Ebenavia horni*, sp. nov.

*Description.*—Head long, depressed; snout rather obtuse, about as long as the distance between the eye and the ear-opening. Pupil vertical. Ear-opening small, round. Limbs short and slender. Tail depressed, constricted at the base. Digital expansions twice the diameter of the digit. Lamellæ under the fourth toe eight, separated from the expansions by rows of granules. Dorsal surfaces of expansions scaled as in *Phyllodactylus.* Upper surfaces of body covered with uniform small, oval scales; scales on the head round, smallest on the occiput, largest and flattest on the snout. Rostral very low, four-sided, four times as broad as high. Nostril pierced between first labial and three or four nasals; first nasal largest, separated from its fellows on the opposite side by a single equal scale, thus forming a line of three scales behind the rostral. Nine upper labials. Mental narrow, triangular, about as large as adjacent lower labials; latter nine in number. No special chin-shields, but the gular scales near the symphysis larger than those behind. Ventral scales smooth, tesselated, larger than dorsal. Tail with annuli of small smooth scales. *Colour.*—Olive-brown above, with four longitudinal dark bands, two converging from the occiput to unite over the sacrum, and one on each side passing from the nostril through the eye and above the limbs. On the side another dark band from ear, just above the fore-limb to the

groin. Under surfaces brownish-grey with scattered brown dots. Tail brown above with lighter ocelli, each occupying about four scales; below with intermingled grey and brown scales.

DIMENSIONS.

| | | | |
|---|---|---|---|
| Total length | ... | ... | 55 mm. |
| Head | ... | ... | 10 „ |
| Width of head | ... | ... | 5 „ |
| Body | ... | ... | 23 „ |
| Fore-limb | ... | ... | 9 „ |
| Hind-limb | ... | ... | 12 „ |
| Tail | ... | ... | 22 „ |

Since Mr. Boulenger has withdrawn his species *E. boettgeri*, (Cat., vol. iii., p. 482), only one *Ebenavia* has been previously recognised, and that only from Madagascar. In general outline the present species closely agrees with Mr. Boulenger's figure (Cat., vol i., pl. viii., fig. 1), and the colour bands agree fairly with those of his Madagascar specimen. The chief point of distinction in the Australian form is the entire absence of anything like longitudinal series of large tubercles.

The nearest allies to the clawless genus *Ebenavia* are met with in the genus *Phyllodactylus*. Species of *Phyllodactylus* occur in South Africa and Madagascar. Indeed, only the most trivial differences can be found between *P. porphyreus*, Daud., from these localities, and the widely distributed Australian form *P. marmoratus*, Gray.

We have associated the name of Mr. Horn with this interesting lizard.

*Tympanocryptis tetraporophora*, sp. nov.

Nostril nearer to eye than to tip of snout; upper head scales larger and less strongly keeled than in *T. lineata*, Peters, large on the occiput. Dorsal scales strongly keeled, the enlarged ones mucronate. *Colour.*—Light brown above or reddish, with darker more or less indistinct cross bands on the body; tail and limbs with dark bars. Resembling *T. cephalus*, Günth., in colouring above, and *T. lineata* on ventral surfaces; but in one of the two specimens there is a narrow white vertebral line recalling that of *T. lineata*.

The remarkable feature of these specimens is that there are in addition to the two anal pores, two femoral pores, one on each limb. This character will involve a modification in the definition of the genus.

Apart from the presence of these pores, *T. tetraporophora* serves to connect the two previously described species of the genus.

DIMENSIONS.

| | | | |
|---|---|---|---|
| Total length | ... | ... | 130 mm. |
| Head | ... | ... ... | 17 ,, |
| Width of head | ... | ... | 13 ,, |
| Body | ... | ... ... | 35 ,, |
| Fore-limb | ... | ... | 28 ,, |
| Hind-limb | ... | ... | 40 ,, |
| Tail | ... | ... ... | 78 ,, |

*Varanus gilleni*, sp. nov.

*Description.*—Snout slightly projecting, depressed at the end, measuring rather less than the distance from the anterior angle of the eye to the ear; canthus rostralis indistinct. Nostril broadly oval, as in *V. punctatus*, *acanthurus*, etc., directed backwards and outwards, slightly nearer the end of the snout than the anterior angle of the eye. Limbs and digits moderate, latter strongly compressed. Tail round, flattened ventrally, depressed at the base, not keeled. Head covered with flat granular scales, unequal in size, largest between the orbits, smallest on the supraocular region and about the nostrils. Scales of upper surfaces small, oval, convex, rather longer than broad, each scale on the body and limbs—except those on the preaxial surface of the carpus and to a less extent the tarsus—surrounded by a conspicuous ring of small granules. About eight rows of flat smooth subequal genal scales. Gular scales similar to abdominal, but more convex. Abdominal scales smooth, in eighty-five to ninety transverse rows between gular fold and groin. Caudal scales all tricarinate, the central keel strongest, raised posteriorly almost mucronate. Pineal cornea distinct, inconspicuous. *Colour.*—Light brown above, with darker spots and streaks, arranged more or less plainly in longitudinal series or continuous

lines on the head and the distal three-fourths of the tail, and in transverse series or bands across the neck, trunk, and proximal fourth of the tail. The markings on the trunk of a dull red. Six narrow longitudinal bands on the head and front part of the neck, on each side one commencing behind the ear and another more continuous along the temporal region commencing behind the eye, the two median dorsal bands anastomosing with one another and with the temporal streak. Lips with vertical streaks. Under surfaces cream coloured, chin dark spotted.

Dimensions.

| | | |
|---|---|---|
| Total length | 341 | mm. |
| From tip of snout to gular fold | 51 | „ |
| From gular fold to vent | 93 | „ |
| Max. width of head | 17 | „ |
| Fore-limb | 38 | „ |
| Hind-limb | 46 | „ |
| Tail | 197 | „ |

Named after F. J. Gillen, Esq., the chief officer of the Alice Springs Telegraph Station.

*Varanus eremius*, sp. nov.

*Description.*—Snout depressed at the end, measuring less than the distance from the anterior border of the orbit to the ear, canthus rostralis sharp. Nostril round, nearer the end of the snout than the orbit. Digits moderate. Tail round, depressed at the base, compressed posteriorly. Head scales small subequal, supraocular scales very small. Scales of the upper surfaces small, elongate, keeled. Abdominal scales smooth, in seventy to seventy-five transverse rows, caudal scales strongly keeled, the caudal keel with a low doubly-toothed crest. Pineal cornea conspicuous. *Colour.*—Rusty-brown above, with small lighter and darker spots, a dark narrow curved line across the back of the head, and another from above the ear passing through the orbit, lower eye-lid with a large brownish-grey spot, sides greyish, a white streak from the ear to the fore-limb. Tail greyish with four—six on the anterior half—black streaks. Lower surfaces white, throat mottled with grey.

DIMENSIONS.

| | |
|---|---|
| Total length ... ... ... ... | 300 mm. |
| From tip of snout to gular fold ... | 39 „ |
| From gular fold to vent ... ... | 73 „ |
| Max. width of head ... ... | 13 „ |
| Fore-limb ... ... ... ... | 32 „ |
| Hind-limb ... ... ... ... | 46 „ |
| Tail ... ... ... ... ... | 188 „ |

*Rhodona tetradactyla*, sp. nov.

*Description.*—Body much elongate, limbs weak, tetradactyle, the distance between the end of the snout and the fore-limb is contained twice to twice and a half in the distance between axilla and groin. Snout moderate, obtusely conical. Lower eye-lid with a transparent disk. Nostril pierced in a large nasal which is in contact with its fellow; frontonasal large, and forming a broad straight suture with the frontal; præfrontals small and widely separated; frontal broader than the supraocular region, longer than the frontoparietals and interparietal together, in contact with the first and second supraoculars; four supraoculars, six supraciliaries; frontoparietals and interparietal distinct, subequal; two or three pairs of nuchals. Ear-opening minute, about the size of the nostril. Twenty smooth scales round the middle of the body, dorsals largest. A pair of enlarged præanals. The length of the hind-limb equals the distance between the eye and the fore-limb; toes slender, third about twice the length of second, which is twice as long as the first, subdigital lamellæ smooth, about fourteen under the third toe. Tail slightly longer than head and body. *Colour.*—Greyish above, with four regular series of black dots, almost confluent into lines along the back, sides darker, a longitudinal blackish lateral band from snout to tail, the lower edge of which is scarcely distinct from the darker ground colour on the sides; tail brownish, covered with irregular blackish dots; lower surfaces greyish or brownish with a darker colour around the margin of each scale.

DIMENSIONS.

| | | | | |
|---|---|---|---|---|
| Total length | ... | ... | 77 | mm. |
| Head ... | ... | ... | 5 | „ |
| Width of head | ... | ... | 3 | „ |
| Body ... | ... | ... | 30 | „ |
| Fore-limb | ... | ... | 4 | „ |
| Hind-limb | ... | ... | 8 | „ |
| Tail ... | ... | ... | 42 | „ |

*Ablepharus lineo-ocellatus*, D. and B.

Var. *ruficaudus*, var. nov.

Differs from the type as follows:—Body much depressed. Twenty-eight scales round the middle of the body. Nuchals nearly as large as parietals. *Colour.*—Upper surfaces greenish-black, with conspicuous longitudinal white band on either side of the back and head, converging in front to meet on the tip of the snout, and behind extending to base of tail. Tail and hind-limbs red. Under surfaces of body bluish-white, of tail reddish.

## Art. XXVII.—*Some Quantitative Laws of Incubation and Gestation.*

By Alexander Sutherland, M.A.

[Read 13th December, 1894.]

It is known in a general way that the time required for hatching out the eggs of cold-blooded animals is dependent on the temperature at which they are kept. Professor McIntosh ("Nature" xxxi., p. 555) says that salmon eggs left in the sea, take from 95 to 120 days to hatch, but that when transferred to a warm room they hatch in 60 days. Bertram, in his "Harvest of the Sea," says that herring eggs will hatch slowly or quickly according to the temperature, a difference of 50 days being possible. As a rule herring eggs take from 11 to 40 days, graylings from 14 to 40, codfish 5 to 42, tench 6 to 14, gurnards 7 to 35, stickleback 10 to 30, and so on, the higher the temperature the less the time. But in connection with a book on which I have long been busy, I required more definite information as to the relation of hatching-time to temperature, and therefore I instituted a long series of hatchings of frogs' eggs. During two winters I took the eggs of a species which Professor Spencer identified for me as *Hyla aurea*, and hatched its eggs in sets at graduated temperatures. This species extrudes an unusual number of eggs, the average of 14 sets that I counted being over 3000 to each. It was easy therefore to get ten sets of 100 each, which could with certainty be regarded as of similar condition. I put them over lamps and kept them at temperatures, as nearly uniform as I could, ranging from 10° C. to 33° C.

Six series of experiments thus conducted satisfied me that the time required for hatching was inversely proportional to the square of the excess of the temperature above a certain fixed temperature. But in every series there occurred one or more failures through accidental variations in temperature. I, therefore, in September last, carried out a new series of experiments, floating each set of eggs in a large body of water which could not easily vary during intervals between observation. Even here one set was somewhat affected by a rise of 3° C. lasting for 4 hours,

during an unavoidable absence. I give the table herewith, without any attempt at compensating for errors. The law which they clearly indicate is that

$$t = \frac{m}{(T+a)^2}$$

where $t$ is the time of hatching, T is the temperature at which the eggs are kept; $m$ and $a$ are constants, the latter being of course the fixed temperature referred to. The last column gives the time (in hours) which the eggs would have taken to hatch according to this law, assuming $m = 40,200$; and $a = 1{\cdot}3°$ C. for this species.

TABLE I.

| No. | Average Temperature. | Time Observed. | Time Calculated. |
|---|---|---|---|
| 1 | 31·6° C | Killed by heat. | |
| 2 | 29·3° C | 43 hours | 42·9 hours |
| 3 | 28° C | 45 ,, | 46·8 ,, |
| 4 | 24·1° C | 62 ,, | 62·2 ,, |
| 5 | 22·8° C | 68 ,, | 69·3 ,, |
| 6 | 21·7° C | 71 ,, | 76 ,, |
| 7 | 17·6° C | 114 ,, | 113·5 ,, |
| 8 | 17·5° C | 114 ,, | 114 ,, |
| 9 | 15·8° C | 138 ,, | 137·5 ,, |

No. 6 is the set already referred to as having been marred by an accident; but the general agreement of the figures can leave no doubt as to the accuracy of the law.

In the formula given it is plain that a temperature of $-1{\cdot}3°$ C. would be that at which the eggs would take an infinite time to hatch, or, in other words, would never hatch at all; but at temperatures somewhat above this we may be sure that other circumstances would interfere to prevent the development of the tadpole.

The quantity $m$ is constant only for a given species; but in what follows of this paper, enough will be seen to make it probable that in comparing species with species, it is a quantity varying directly as the sixth root of the weight of the fully matured animal. So far as I can depend on the very few and very rough observations made as to the hatching time of lizards,

snakes, turtles and alligators, this belief is fairly well borne out. But, as the unreliable nature of these figures prevents more than a sort of *prima facie* evidence, let me pass by preference to others in which there is more accuracy, though still the observations are often merely approximate.

All birds and mammals, except the monotremata, and, as I shall show in a future paper, the marsupiata, keep at a temperature which may, for the purposes of this enquiry, be considered constant, so that in the following investigation we may neglect temperature variations, as the figures to be dealt with are not accurate enough to allow of refined adjustments. Excluding the monotremata and marsupiata, the extremes of health temperature for birds and mammals would be 37° C. and 43° C., or a range of only 6° C. We may therefore assume that all birds sitting on their eggs keep them at a tolerably definite temperature. Any given species, therefore, will take a certain fairly definite time to hatch out its eggs. Temperature, we know, counts for something; a set of hen, duck or turkey eggs placed in a warm dry situation will hatch out two or three days before another set in a damp cold place. But, in view of the roughness of the observations of naturalists, we shall assume that each species takes a tolerably definite time in hatching, the hen for instance, 21 days, and the turkey, 28.

What, then, is the reason for the difference in time, seeing that in all cases the temperatures are much the same? Why does a humming-bird take 10 days, or a wren 10, while a dove takes 18, a fowl 21, a turkey, 28, an ostrich about 50? St. George Mivart says: "The period of incubation is much related to the size of the bird." I propose in this paper to determine the nature of that relation, and to show that the time of incubation is directly proportional to the sixth root of the weight of the bird when mature.

The following preliminary table will serve to illustrate this relation and show that $t = n\sqrt[6]{w}$, where $t$ = time in days.

$w$ = weight in lbs.

$n = 20$.

TABLE II.

| Name. | Weight. | Time Observed. | Time Calculated. |
|---|---|---|---|
| Humming Bird - - | 150 grains | 10 days | 10·5 days |
| Wren - - - - | 135 „ | 10 „ | 10·3 „ |
| Goatsucker - - | 2¼ oz. | 14 „ | 14·6 „ |
| Lark - - - - | 4 „ | 15 „ | 15·8 „ |
| Kingfisher - - - | 7½ „ | 17 „ | 17·6 „ |
| Pigeon - - - | 12¼ „ | 18 „ | 19 1 „ |
| Pheasant - - - | 2¼ lbs. | 24 „ | 23·3 „ |
| Common Fowl - - | 3 „ | 21 „ | 24 „ |
| Guinea Hen - - | 9 „ | 28 „ | 28·9 „ |
| Duck - - - - | 6 „ | 28 „ | 27 „ |
| Turkey - - - | 12 „ | 29 „ | 30·2 „ |
| Goose - - - - | 12 „ | 32 „ | 30·2 „ |
| Eagle - - - - | 12 „ | 30 „ | 30·2 „ |
| Ostrich - - - | 250 „ | 38 to 60 days | 50·1 „ |

In an appendix to this paper I shall give a list of 105 birds, for which I have been able to obtain records of the weight and of the incubation period of each. I have, indeed, found records of the weights of over 500 species and incubation periods of an almost equal number; but in only these 105 cases can both items of information be had for the same bird. They are sufficient, however, to show that the law enunciated holds good with only one notable exception, the Apteryx, which is wholly isolated if the figures given by Buller are to be accepted. There is one dubious case—the Emu. But in such an enquiry allowance must be made for the want of definiteness in the figures. Many observers are content to say that a bird broods for 3 or 4 weeks. Even so careful a writer as Brehm, gives very many of his incubation periods in the same inaccurate fashion. Nor do the authorities agree well together. For a bird so well-known as the Swan, Brehm gives 48 days as the period; poultry books say 6 weeks, while Bechstein, a very competent authority, gives 5 weeks. In regard to the ostrich, Anderson gives 38 days, Brehm gives 45 to 52, while St. George Mivart says 50 to 60, and half-a-dozen other authorities give various intermediate periods. In all such cases I have taken the mean. But there are many, no doubt, not to be accepted as more than very rough approximations.

In a few cases where, instead of the name of the authority for the weight, the word "calculated" occurs, it means that, being unable to find the weight of a species, but having discovered that of a closely allied species, presumably of the same shape, I have calculated the weight of the one from that of the other on the assumption that they are proportional to the cubes of the lengths.

If we apply the same sort of investigation to the Mammalia as a whole, we find that for the period of gestation the law

$$t = n \sqrt[6]{w}$$

holds with only moderate accuracy. But if we consider any one order at a time, the coincidence of observed and calculated times is sufficient to establish the law conclusively. For instance, the following is a list of all the carnivora for which I can obtain information. For this order the constant $n$ is equal to 41.

TABLE III.

| Popular Name. | Specific Name. | Weight, in lbs. | Authority. | Time Calculated. | Time Observed. | Authority. |
|---|---|---|---|---|---|---|
| | | | | Days. | Days. | |
| Cat | Felis maniculata | 6 | Experiment | 55 | 55 to 56 | Mivart, Brehm, &c. |
| Wild Cat | Felis catus | 16 | Brehm | 65 | 63 | Brehm |
| Lynx | Lynx vulgaris | 18 | Brehm | 66·5 | 70 | Brehm |
| Chaus | Lynx chaus | 15 | Brehm | 64·4 | 70 | Brehm |
| Lion | Felis leo | 490 | Jerdon | 113 | 110 | Average of seven |
| Puma | Felis concolor | 160 | Calculated | 95·5 | 96 | Brehm |
| Tiger | Felis tigris | 332 | Brehm | 108 | 100 to 105 | Brehm |
| Leopard | Felis panthera | 150 | Calculated | 94·7 | 90 | Brehm |
| Ferret | Putorius furo | 1 | Cyclopædia | 41 | 35 | Brehm |
| | | | | | 42 | Vogt. |
| Weasel | Putorius vulgaris | $\frac{1}{4}$ | Cyclopædia | 36·5 | 35 | Brehm |
| Otter | Lutra vulgaris | 19 | Flower & Lydekker | 67 | 63 | Brehm |
| Polecat | Putorius fœtidus | 6 | | 55 | 55 to 60 | Brehm |
| Wolverine | Gulo borealis | 96 | Brehm | 87·7 | 90 | Vogt. |
| Marten | Mustela martes | 8 | | 57 | 63 | Brehm |
| Badger | Meles taxus | 44 | Brehm | 77·1 | 84 to 105 | Brehm |
| Racoon | Procyon lotor | 15 | Cyclopædia | 64·4 | 63 to 70 | Brehm |
| Brown Bear | Ursus formicarius | 550 | Brehm | 187 | 180 | Vogt |
| Polar Bear | Ursus maritimus | 800 | Vogt. | 199 | 210 | Brehm |
| Land Bear | Ursus arctos | 440 | Brehm | 180 | 180 | Brehm |
| Jackal | Canis aureus | 22 | Brehm | 74·7 | 63 | Brehm |
| Wolf | Canis lupus | 90 | Brehm | 86·9 | 70 | Landois |
| Fox | Canis vulpes | 6 | Jerdon | 55 | 62 | Brehm |
| | | 16 | Brehm | 65 | 63 | Landois |

The dog family are here the most abnormal, and, among domesticated dogs, although the larger varieties have a longer gestation period than the smaller, the difference is not sufficient to make the times accord with the law given.

The ruminants form another group fairly consistent within itself; but for them the constant $n$ must be made equal to 80.

The camel and giraffe families are left out of the following list, the former for want of weights of individuals, the latter because the gestation period is abnormally long. But of the Cervidæ, Capridæ, and Bovidæ, the following are all the species for which I can find both weights and gestation periods recorded.

TABLE IV.

| Popular Name. | Specific Name. | Weight, in lbs. | Authority. | Time Calculated. | Time Observed. | Authority. |
|---|---|---|---|---|---|---|
| | | | | Days. | Days. | |
| Roebuck | Capreolus caprœa | 50 | Brehm | 153 | 160 | Brehm |
| Stag | Cervus elaphus | 450 | Brehm | 221 | 280 | Brehm |
| Fallow Deer | Dama vulgaris | 220 | Brehm | 196 | 240 | Brehm |
| Elk | Alces palmatus | 750 | Brehm | 242 | 259 | Brehm |
| Saiga | Colus tartaricus | 120 | Brehm | 178 | 165 | Brehm |
| Gemsbok | Capella rupicapra | 90 | Brehm | 169 | 150 | Brehm |
| Goral | Nemorhœdus goral | 200 | Jerdon | 193 | 180 | Brehm |
| Nilgau | Portax pictus | 800 | Brehm | 244 | 240 | Brehm |
| Elend | Busephalus oreas | 1000 | Brehm | 253 | 282 | Brehm |
| Koodoo | Strepsicorus kudu | 400 | Brehm | 217 | 210 to 240 | Brehm |
| Wild Cattle | Bos taurus | 800 | Brehm | 244 | 280 | Brehm |
| Bison | Bison europæus | 1320 | Brehm | 265 | 280 | Brehm |
| Yak | Bos grunniens | 1100 | Brehm | 257 | 270 | Brehm |
| Musk Ox | Ovibos moschatus | 800 | Brehm | 244 | 270 | Brehm |
| Mufflon | Ovis musimon | 100 | Brehm | 172 | 147 | Brehm |
| Argali | Ovis argali | 400 | Brehm | 217 | 210 | Brehm |
| Ibex | Capra ibex | 170 | Brehm | 188 | 150 | Brehm |
| Reindeer | Rangifer tarangus | 400 | Cyclopædia | 217 | 210 | Brehm |
| Musk Deer | Moschus moschiferus | 50 | Cyclopædia | 153 | 180 | Brehm |
| Sheep | Ovis aries | 100 | Av. of 7 weighed | 172 | 150 | Av. of 5 observers |
| Goat | Capra hircus | 100 | Calculated | 172 | 154 | Av. of 4 observers |

More accurate results may be had by taking the families separately and adopting for each its own value of $n$, these values being nearly, but not quite, equal. In the same way by putting $n = 55$ we find that the *Suidæ* and *Hippopotamidæ* make a consistent group, though not running uniformly with the rest of the *Artiodactyls.*

The period of gestation among these animals is generally only roughly determined by observing in what months the sexes come together, and then observing in what month the young are born. How fallacious this may be has been shown by Bischoff in the case of the Roebuck, the female of which does not produce her young until more than nine months after the rutting season. But it is now known that this is not the period of gestation, for the spermatozoa lie for four months in the uterus without fertilising the ovum, so that the real period is only some five months. The same phenomenon is observed with bats and other mammals. Selenka has shown that with the Virginian Opossum the time from copulation to birth is 13 days while the actual time of gestation is only $7\frac{5}{6}$ days. So in the U.S. Fisheries' Report of 1884, the statement is made that while the males of *Embiotocidæ* impregnate the females in autumn the young are born alive in the following summer. Hence the spermatozoa must lie inactive for many months.

It is quite probable, as the foregoing list suggests, that beside the Roebuck, there are other species of deer in which the same peculiarity occurs to a less extent. Perhaps the same thing occurs in the case of the Beaver which is a very aberrant species, as will be seen from the list given in the appendix of all the Rodentia for which information is available. The *Perissodactyla* make another consistent group. All the species for which information is available are given in the appendix.

In dealing with the mammals we have found it necessary to give different values to the constant. There are two biological reasons for this. The first is that some animals are carried by their mothers till fairly well able to take care of themselves. A calf, or a foal, or a young deer is sufficiently matured to trot after its mother in a few hours after birth; while a kitten, or a puppy, or a tiger cub is for a long time helpless. One animal therefore remains in its mother's womb until tolerably complete

as compared with another. This causes the value of $n$ to be high in ruminants, and higher still in Proboscidea; while in Carnivora and Rodentia it is low, but of approximately equal value, 41 for the first; 35 for the second.

The first law, stated in its most general form, is this:—"For animals of the same size the time of embryo development is inversely proportional to the square of the temperature, that temperature being reckoned from a definite point."

The second law, similarly stated, is that:—"At the same temperature, the period of development is directly proportional to the sixth root of the weight of the mature animal."

This latter law is capable of a certain simplification. If two animals are of different sizes, but of the same shape, the weights of their bodies are proportional to the cubes of their lengths. The law in that case would be:—At the same temperature, among animals of the same shape, the period of development is directly proportional to the square root of the length.

Thus we have

$$t = n\sqrt{l}$$

but this is the same as

$$l = ft^2$$

where $f = \frac{1}{n^2}.$

Now this is the well-known equation for the space traversed by a body moving under the influence of a constantly accelerating force, and the significance of the law therefore is that if we consider the germinal point as the starting place, and imagine the embryo to travel outwards from it to the periphery, the velocity of the motion will be such as would result from a constantly accelerating force propelling it from the germinal spot outwards.

In the appendix a list is given of the gestation periods of the rodents, the family Leporidæ being set down apart from the others as requiring a lower value of the constant. The Beaver is a very aberrant case. The only four species of Perissodactyls for which I can get information form a fairly consistent group. For them the value of the constant is very high, but in the Proboscidea it rises higher than in any other of the lower families, reaching a value of 120. In the Prosimia it appears to be only equal to the value of $n$ in the ruminants; but in the Quadrumana

it rises to 160, and in mankind remains at about the same value.

This increase in the value of $n$ as nerve development progresses, is a ready corollary from Von Baer's law, but many difficulties arise in the attempt to work out the relation in a general way.

One may almost risk the prediction that the laws above stated will be found to combine in this fashion:—

I.—Reckoning $t$ to be the time from the fusion of the nuclei to some definite point in development, say, the capacity of the young animal to stand, walk or swim; T to be the temperature at which development takes place, and $w$ to be the weight of the mature animal. Then as a first approximation

$$t = \frac{k \sqrt[6]{w}}{T^2}$$

T being reckoned from a definite point; not necessarily any of the recognised zeros.

II.—But the quantity $t$ tends decidely to increase with increase of nerve complexity, as gauged by size and efficiency of brain.

## APPENDIX I.

### INCUBATION PERIODS OF BIRDS.

$t = n\sqrt[6]{w}$ where $n = 20$.

| Popular Name. | Specific Name. | Weight. | Authority. | Time Calculated. | Time Observed. | Authority. |
|---|---|---|---|---|---|---|
| | | | | Days. | Days. | |
| Swallow - - | Hirundo rustica - - | 1 oz. | Experiment - | 12·5 | 12 | Brehm |
| Canary - - - | Dryospiza canaria - - | 600 grs. | Bp. Stanley - | 13·2 | 14 | Jones |
| Greenfinch - - | Chloris hortensis - - | 480 grs. | Bp. Stanley - | 12 9 | 13 | Jones |
| Goldfinch - - | Carduelis elegans - - | 540 grs. | Bp. Stanely - | 13 1 | 13 | Jones |
| Goatsucker - - | Caprimulgus kelnartii - | 2½ oz. | Jerdon - - | 14·6 | 14 | Jerdon |
| Trogon - - - | Harpactes fasciatus - | 2½ oz. | Audubon - - | 14·6 | 20 (?) | Brehm |
| Halcyon - - | Halcyon leucocephalus - | 7¾ oz. | Audubon - - | 17·6 | 17 | Brehm |
| Woodpecker - - | Chrysocolaptes sultaneus - | 6 oz. | Jerdon - - | 17 | 14 | Jerdon |
| Hedge Sparrow - | Tharraleus modularis - | 1 oz. | | 12·5 | 14 | Jones |
| Wryneck - - | Yunx torquilla - - | 1½ oz. | Jerdon - - | 13·4 | 14 | Brehm |
| Nuthatch - - | Sitta cæsia - - | ½ oz. | Jerdon - - | 11·2 | 13 | Brehm |
| Shrike - - - | Lanius lahtora - - | 2 oz. | Jerdon - - | 14 1 | 15 | Brehm |
| Woodshrike - - | Tephrodornis silvicola - | 1½ oz. | Jerdon - - | 13·4 | 13 | Brehm |
| Wren (Common) - | Troglodytes ædon - - | 135 grs. | White's Selborne | 10·3 | 10 | Mivart |
| Wren (Winter) - | Troglodytes hiemalis - | 300 grs. | Audubon - - | 11·9 | 13 | Brehm |
| Girlitz - - - | Serinus hortulans - - | 320 grs. | Audubon - - | 12 | 10 | Newton |
| Chaffinch - - | Tringilla cœlebs - - | 1000 grs. | Audubon - - | 14 4 | 14 | Newton |
| Lark - - - | Alauda arvestris - - | 1700 grs. | Audubon - - | 15·8 | 15 | Newton |
| House-Sparrow - | Passer domesticus - - | 1000 grs. | Audubon - - | 14 4 | 14 | Newton |
| Piping Crow - - | Gymnorhina tabicen - | 5700 grs. | Experiment - | 19·3 | 21 | Brehm |
| Martin - - - | Chelidon urbica - - | 500 grs. | Calculated - | 12·9 | 12 | Brehm |

INCUBATION PERIODS OF BIRDS.—*(Continued).*

| Popular Name. | Specific Name. | Weight. | Authority. | Time Calculated. | Time Observed. | Authority. |
|---|---|---|---|---|---|---|
| | | | | Days. | Days. | |
| Sand Martin | Cotyle riparia | 400 grs. | Calculated | 12·4 | 14 | Brehm |
| Flycatcher | Muscicapa albicollis | 600 grs. | Calculated | 13·2 | 14 | Brehm |
| Robin Red-breast | Erithacus rubeolus | 700 grs. | Calculated | 13·7 | 14 | Brehm |
| Sedge Warbler | Calamodus phragmitis | 500 grs. | Calculated | 12·9 | 14 | Brehm |
| Pendulous Titmouse | Ægithalus pendulinus | 400 grs. | Calculated | 12·4 | 14 | Brehm |
| Long-tailed Tit | Orites caudatus | 500 grs. | Calculated | 12·9 | 13 | Brehm |
| Honeysucker | Nectarinia metallica | 600 grs. | Calculated | 13·2 | 14 | Brehm |
| Humming Bird | Trochilus colubris | 150 grs. | Calculated | 10·5 | 10 | Brehm |
| | | 12 lbs. | Jerdon | 30·2 | 35 | Brehm |
| Eagle (Golden) | Falco chrysaëtos | 15 lbs. | Jerdon | 31·4 | 21 to 35 | |
| | | 11 lbs. | Audubon | 29·8 | 21 | Gray |
| Snake Buzzard | Circaëtus brachydactylus | 4¼ lbs. | Jerdon | 25·4 | 28 | Jerdon |
| Osprey | Pandion haliætus | 3½ lbs. | Jerdon | 24·7 | 24 | Brehm |
| Vulture | Vultur cinereus | 19 lbs. | Jerdon | 32·6 | 32 | Brehm |
| Kite | Hydroictinia govinda | 7½ oz. | Jerdon | 17·7 | 21 | Brehm |
| Goshawk | Astur palumbarius | 46 oz. | Jerdon | 17·6 | 18 to 20 | Brehm |
| Wood Owl | Syrnium newarnese | 2⅓ lbs. | Jerdon | 23 | 21 | Brehm |
| Eared Owl | Strix otus | 8 oz. | Jerdon | 17·8 | 21 | Brehm |
| Scops Owl | Ephialtes pennatus | 2¾ oz. | Jerdon | 16·7 | 21 | Brehm |
| Owlet | Athene brama | 4 oz. | Jerdon | 15·9 | 15 | Brehm |
| Stock Dove | Palumbœna eversmanii | 7½ oz. | Jerdon | 17·6 | 17 | Brehm |
| Ring Dove | Columba palumbus | 6½ oz. | Jerdon | 17·2 | 17 | Darwin |
| Pigeon | Columba livia | 12¼ oz. | Darwin | 19·1 | 18 | Brehm |
| Common Fowl | Gallus | 4 lbs. | Experiment | 25·1 | 21 | Brehm |

INCUBATION PERIODS OF BIRDS.—*(Continued).*

| Popular Name. | Specific Name. | Weight. | Authority. | Time Calculated. | Time Observed. | Authority. |
|---|---|---|---|---|---|---|
| | | | | Days. | Days. | |
| Jungle Fowl | Gallus ferrugineus | 2 lbs. | Le Messurier | 22·5 | 21 | Brehm |
| Pheasant | Phasianus colchicus | 2½ lbs. | Brehm | 23·3 | 24 | Brehm |
| Guinea Hen | Numida meleagris | 9 lbs. | Poultry Books | 28·9 | 28 | Poultry Books |
| Peahen | Pavo cristatus | 8½ lbs. | Le Messurier | 28·6 | 28 | Poultry Books |
| | | | | | 30 | Brehm |
| Turkey | Meleagris gallopavo | 10 lbs. | Exp. average of 7 | 29·3 | 27 to 30 | Brehm |
| Horned Pheasant | Ceriornis satyra | 4½ lbs. | Jerdon | 25·6 | 26 | Brehm |
| Kaly Pheasant | Gallophasis albocristatus | 3 lbs. | Jerdon | 24 | 24 | Brehm |
| Himalaya Snowcock | Tetraogallus himalayensis | 6½ lbs. | Jerdon | 27·3 | 28 | Brehm |
| Snow Partridge | Lerwa nivicola | 18 oz. | Jerdon | 20·7 | 22 | Brehm |
| Chukkor Partridge | Caccabis chukor | 20 oz. | Jerdon | 20·8 | 22 | Brehm |
| Common Quail | Coturnix communis | 3¾ oz. | Jerdon | 15·7 | 18 | Brehm |
| Godwit | Scolopax hudsonica | 9 oz. | Audubon | 18·2 | 17 to 18 | Brehm |
| Woodcock | Scolopax rusticola | 12 oz. | Jerdon | 19 | 18 | Brehm |
| Woodsnipe | Gallinago nemoricola | 6 oz. | Jerdon | 17 | 18 | Brehm |
| Common Snipe | Gallinago scolopacinus | 4½ oz. | Jerdon | 16·2 | 15 | Brehm |
| Curlew, Red-billed | Ibidorhynchus struthersii | 9½ oz. | Jerdon | 18·3 | 16 | Brehm |
| Ruff | Philomachus pugnax | 6 oz. | Le Messurier | 17 | 19 | Brehm |
| | | | | | 21 | Jones |
| Partridge | Perdix cinerea | 1 lb. | Audubon | 20 | 22 | Audubon |
| | | | | | 26 | Brehm |
| Sandpiper | Tringa subarquata | 2¼ oz. | Audubon | 13·8 | 14 | Brehm |
| Sea Sandpiper | Tringa maritima | 3¼ oz. | Audubon | 14·7 | 16 to 17 | Brehm |
| Heron | Ardea nobilis | 4 lbs. | Le Messurier | 25·1 | 21 | Brehm |

INCUBATION PERIODS OF BIRDS.—*(Continued).*

| Popular Name. | Specific Name. | Weight. | Authority. | Time Calculated. | Time Observed. | Authority. |
|---|---|---|---|---|---|---|
| | | | | Days. | Days. | |
| Ibis - - - | Geronticus papillosus - | 3¼ lbs. | Jerdon - - | 24·3 | 25 | Brehm |
| Stork - - - | Ciconia alba - - | 8 lbs. | Le Messurier - | 28·3 | 28 to 31 | Brehm |
| Flamingo - - | Phœnicopterus roseus - | 10 lbs. | Jerdon - - | 29·3 | 32 | Brehm |
| Clattering Rail - | Rallus crepitans - - | 11 oz. | Audubon - - | 18·8 | 21 | Brehm |
| Gallinule - - | Gallinula chloropus - | 12 oz. | Audubon - - | 19·1 | 20 | Brehm |
| Prairie Hen - - | Tetrao cupido - - | 2 lbs. | Audubon - - | 22·5 | 18 or 19 | Brehm |
| Knot - - - | Tringa islandica - - | 6 oz. | Audubon - - | 17 | 16 | Brehm |
| Avocet - - - | Recurvirostrata americana | 15 oz. | Audubon - - | 19·8 | 17 to 18 | Brehm |
| Stilt - - - | Himantopus ingricollis - | 5¾ oz | Audubon - - | 16·9 | 16 | Brehm |
| Swiss Plover - - | Charadrius helveticus - | 6½ oz. | Audubon - - | 16·5 | 16 | Brehm |
| Shield Drake - - | Vulpanser tadorna - | 3 lbs. | Audubon - - | 24 | 26 | Jones |
| Domestic Duck - | Anas domestica - - | 6 lbs. | Exp. average of 7 | 27 | 28 | Poultry Books |
| Mallard - - | Anas boschus - - | 2¾ lbs. | Audubon - - | 23·6 | 21 | Landois |
| Teal - - - | Querquedula angustirostris | 24 oz. | Le Messurier - | 21·4 | 21 | Brehm |
| Wild Goose - - | Anser cinereus - - | 12 lbs. | Jerdon - - | 30·2 | 32 | Brehm |
| Cormorant - - | Phalocrocorax carbo - | 7½ lbs. | Audubon - - | 28 0 | 28 | Brehm |
| Crested Grebe - - | Podiceps cristatus - - | 2½ lbs. | Audubon - - | 23·3 | 21 | Brehm |
| | | 2¼ lbs. | Bp. Stanley - | 23 | | |
| Pochard - - | Clangula glaucion - - | 2 lbs. | Le Messurier - | 22·5 | 22 | Brehm |
| Snow Goose - - | Anser hyperboreus - | 6¾ lbs. | Audubon - - | 27·5 | 28 | Brehm |
| Canada Goose - - | Anser canadiensis - | 6½ lbs. | Audubon - - | 27·3 | 28 | Brehm |
| Ruddy Sheldrake - | Casarca rutila - - | 4 lbs. | Jerdon - - | 25·1 | 22 to 23 | Naumann |
| Pelican - - | Pelecanus onocrotalus - | 25 lbs. | Jerdon - - | 34·2 | 38 | Brehm |
| Oyster Catcher - | Hæmatopus palliatus - | 1¼ lbs. | Jerdon - - | 20·8 | 21 | Brehm |

INCUBATION PERIODS OF BIRDS.—*(Continued)*.

| Popular Name. | Specific Name. | Weight. | Authority. | Time Calculated. | Time Observed. | Authority. |
|---|---|---|---|---|---|---|
| | | | | Days. | Days. | |
| Seagull | Larus argentatus | 12 oz. | Average of several | 19 | 18 | Brehm |
| Spotted Redshank | Totanus fuscus | 8 oz. | Le Messurier | 17·8 | 15 | Brehm |
| Swan | Cygnus buccinator | 19⅓ lbs. | Audubon | 32·8 | 35 | Bechstein |
| Skua | Lestris catarractes | 3 lbs. | Calculated | 24 | 28 | Brehm |
| Herring Gull | Larus argentatus | 22 oz. | Audubon | 21·1 | 18 | Brehm |
| Guillemot | Uria troile | 2 lbs | Audubon | 22·5 | 24 | Brehm |
| Large-billed Guillemot | Uria brunnichii | 2¼ lbs. | Audubon | 23 | 30 | Brehm |
| Cormorant | Phalocrocorax floridanus | 3½ lbs. | Audubon | 24·7 | 28 | Brehm |
| Pomarine Jager | Lestris pomarinus | 1½ lbs. | Audubon | 21·4 | 28 (?) | Brehm |
| Red-headed Duck | Ferina anas | 2lbs. 7oz. | Audubon | 23·2 | 22 | Brehm |
| Bonaparte's Seagull | Larus bonaparti | 10 oz. | Audubon | 18·5 | 18 | Brehm |
| Ostrich | Struthio camelus | 250 lbs | Various | 50·1 | 50 to 60 | Mivart |
| | | 165 lbs. | Brehm | 46·7 | 45 to 52 | Brehm |
| Apteryx | Apteryx oweni | 4 lbs. | Buller | 23·3 | 38 | Anderson |
| | | | | | 42 | Buller |
| Great Bustard | Otis tarda | 20 lbs. | Jerdon | 33 | 29 | Brehm |
| Indian Bustard | Eupodotis edwardsii | 27 lbs. | Jerdon | 34·6 | 35 | Brehm |
| Rhea | Rhea americana | 54 lbs. | Calculated | 38·9 | 39 | Brehm |
| Emu | Dromæus novæ-hollandiæ | 100 lbs. | Calculated | 43·1 | 58 (?) | Brehm |
| | | | | | 49 | Sclater |
| | | | | | 30 | Wallace |
| Cassowary | Casuarius galeatus | 100 lbs. | Calculated | 43·1 | 58 | Brehm |
| | | | | | 52 | Nicholls |
| | | | | | 65 | Landois |

## Appendix II.

RODENTS (excluding Leporidæ). $t = n \sqrt[6]{w}$ where $n = 35$.

| Popular Name. | Specific Name. | Weight. | Authority. | Time Calculated. | Time Observed. | Authority. |
|---|---|---|---|---|---|---|
| | | | | Days. | Days. | |
| Mouse | Mus musculus | 1 oz. | Average of 7 | 22 | 22 to 24 | Weissman |
| Rat | Mus decumanus | 12 oz. | Average of several | 33·4 | 35 | Landois |
| Marmot | Arctomys alpinus | 2 lbs. | Calculated | 39·3 | 35 | Brehm |
| Beaver | Castor fiber | 35 to 58lbs. | Morgan | 66·4 | 90 to 120 | Morgan |
| | | 44 to 66lbs. | Brehm | 68·3 | | |
| Dormouse | Myoxus glis | 4 oz. | Cyclopædia | 27·8 | 24 to 30 | Brehm |
| Squirrel | Sciurus europæus | 8 oz. | Brehm | 31·2 | 28 | Brehm |
| Guinea-Pig | Anæma porcellus | 2 lbs. | Experiment | 39·3 | 49 | Landois |
| | | 1lb. 3oz. | Darwin | 36·1 | 28 to 35 | Brehm |
| Zizel | Spermophilus citillus | 1 lb. | Brehm | 35 | 25 to 30 | Brehm |
| Porcupine | Histrix cristatus | 33 to 44lbs. | Brehm | 64·2 | 49 to 63 | Brehm |

LEPORIDÆ. $t = n \sqrt[6]{w}$ where $n = 24$.

| Popular Name. | Specific Name. | Weight. | Authority. | Time Calculated. | Time Observed. | Authority. |
|---|---|---|---|---|---|---|
| Rabbit | Lepus cuniculus | $2\frac{3}{4}$ lbs. | Average of 4 | 30 | 30 to 32 | Various |
| Hare | Lepus vulgaris | 8 lbs. | Average of 3 | 34 | 32 | Landois |

PERISSODACTYLA. $t = n \sqrt[6]{w}$ where $n = 108$.

| Popular Name. | Specific Name. | Weight. | Authority. | Time Calculated. | Time Observed. | Authority. |
|---|---|---|---|---|---|---|
| Horse | | 823 lbs. | Stonehenge | 331 | 330 | Brehm, Youatt, &c. |
| Ass | | 400 lbs. | Calculated | 293 | 290 | Brehm |
| Tapir | | 1500 lbs. | Calculated | 366 | 315 | Brehm |
| Rhinoceros | | 4500 lbs. | Brehm | 439 | 510 to 540 | Brehm |

## Art. XXVIII.—*Contributions to a knowledge of the Rhynchota of Australia.*

By E. Bergroth, M.D.

[Communicated by Professor Baldwin Spencer.]

Through the kindness of Mr. Charles French, of Melbourne, I have received for examination a considerable number of Australian Rhynchota Heteroptera, many of which are new to science and some of great interest, either as belonging to groups or genera not hitherto recorded from Australia, or as constituting new genera. The following pages are devoted to descriptions of some of the most remarkable of these insects. In a second paper I shall continue these descriptions and give a list of all species.

### Fam. Scutelleridæ.

#### 1. *Philia regia*, n. sp.

Parce subtiliter pilosula. Caput modice declive, longitudine paullo latius, parce punctulatum, supra cupreo-purpureum, lateribus viridi-æneum, subtus cæruleum, rostro flavido, antenuis nigris, articulis duobus primis flavidis, secundo primo breviore, tertio secundo fere duplo longiore. Pronotum lateribus ante medium leviter sinuatum, cupreo-purpureum, lobo antico, margine apicali excepto, viridi-æneo, intra marginem apicalem subuniseriatim punctato, lobo postico antico plus quam duplo longiore, margine laterali flavido. Scutellum flavum, dilute fusco-punctulatum, apice subtruncatum, macula basali subcordata latissima callum basalem includente sed latera haud attingente cupreo-purpurea. Corium limbo costali flavidum. Pectus cæruleum, prope angulos posticos prosterni flavidos cupreo-splendens, sulco orificiali longiusculo, area evaporativa nigra, margine postico metasterni flavido. Abdomen subtus, spatio angusto medio excepto, sat dense et fortiter punctatum, subvirescenti-cæruleum, limbo laterali intus integro et ultra spiracula extenso flavo. Pedes flavi, tibiis cyansis, tarsis fusco-nigris. Long. ♀ 10, 8 mm.

Queensland.

Structurally allied to *Ph. fulgurans*, Stål, but quite differently coloured.

## Fam. PENTATOMIDÆ.

### Sub-fam. PENTATOMINÆ.

### 2. *Cephaloplatys granulatus*, n. sp.

Subobovatus, lurido-stramineus, nigro-punctatus, superne granulis albidis sparsim obsitus. Caput pronoto medio paullo brevius, fortiter parcius punctatum, vitta media supera impunctata præditum, apice leviter incisum, lateribus ante oculos obtuse leviter angulatum, jugis ante tylum contiguis, rostro et articulo primo antenuarum testaceis (ceteri articuli harum desunt). Pronotum antice cum lateribus explanatis fortiter parcius punctatum, parte posteriore densius et minus fortiter punctata, marginibus lateralibus anticis subrectis, crenulatis, angulis opicalibus ultra oculos distincte productis, angulis lateralibus obtusangulariter sinuatis. Scutellum minus dense punctatum, in dimidio basali vitta sublaterali impunctata præditum, punctura intra et præsertim extra has vittas conferta. Pectus parcius fortiter punctatum. Hemelytra apicem abdominis paullum superantia, corio parcius fortiter punctato, paullo extra medium vitta impunctata notato, punctura intra hanc vittam subvittatim nonnihil densata, membrana cinerea, venis circiter sex simplicibus vel furcatis fuscis instructa et inter has remote fuscoguttulata. Abdomen ad angulos apicales segmentorum leviter obtuse prominulum, connexivo nigro-punctato, ventre parce minute fusco-punctulato, spiraculis fuscis. Pedes remote fusco-punctati. Long. ♂ 10, 5 mm.

Queensland.

Very distinct by the granulated upper surface of the body and the impunctate scutellar vittæ.

### 3. *Cephaloplatys reticulatus*, n. sp.

Ovalis, lurido-stramineus, nigro-punctatus. Caput pronoto medio æquilongum, parce fortiter punctatum, apice incisum, lateribus ante oculos acutiuscule angulatum, jugis ante tylum contiguis, rostro et antennis testaceis, articulo harum tertio (ima basi

excepta) et quarto (parte basali excepta) nigris, articulo secundo plus quam dimidio apicem capitis superante, tertio secundo paullo breviore, quarto secundo subæquilongo (art. quintus deest). Pronotum inter angulos laterales fascia subcallosa flexuosa instructum, parcius punctatum, lateribus explanatis multo fortius et remote punctatis, marginibus lateralibus anticis serrulatis, pone medium leviter sinuatis, angulis apicalibus ultra angulum anteocularem distincte productis. Scutellum inæqualiter punctatum. Pectus parcius punctatum. Hemelytra apicem abdominis paullum superantia, corio subacervatim punctato, membrana subcinerea, venis fuscis sat dense reticulatis. Abdomen ad angulos apicales segmentorum leviter prominulum, connexivo remote nigro-punctato, segmentis hujus basi latiuscule, apice anguste nigris, ventre sat parce et fortiter punctato, macula basali media segmentorum nigra. Pedes parce fortiter nigro-punctati. Long. ♂ 11, 8 mm.

Queensland.

At once distinguished from the other species by the reticulated membrane.

### Sub-fam. PHYLLOCEPHALINÆ.

#### 4. *Basicryptus frenchi*, n. sp.

Stramineo-testaceus, dense et sat fortiter nigro-punctatus, macula transversa media ad marginem apicalem pronoti, fascia intus abbreviata ad angulos laterales pronoti exocorioque basin versus nigris, disco pronoti pone medium nigrescente. Caput ante oculos vix sinuatum, vertice gibboso-convexo, jugis tylo multo longioribus, extus subrectis, intus leviter rotundatis et paullo distantibus, antennis nigris, parce testaceo-conspersis, articulo secundo apicem capitis subattingente, tertio secundo paullo longiore, quarto tertio subæquali, quinto quarto distincte longiore. Pronotum linea transversa media callosa impunctata utrinque prope latera oblique antrorsum vergente sed angulos laterales haud attingente instructum, ante hanc lineam fortiter declive, deinde iterum pone medium capitis deplanatum, parte declivi etiam antice linea transversa callosa recta utrinque abbreviata terminata, angulis lateralibus prominulis, acutis, marginibus lateralibus anticis sinuatis, ante medium crenulatis, marginibus

lateralibus posticis anticis longioribus, ad marginem costalem corii obtuse angulatis. Scutellum callo basali medio, callo oblongo prope angulos basales lineisque duabus longitudinalibus callosis ante medium antrorsum leviter divaricatis pallidis impunctatis instructum. Corium quam scutellum minus dense punctatum, venis et margine costali pallidis; membrana albido-hyalina, venis nigris. Segmentum genitale maris apice leviter sinuatum. Pedes dense subconfluenter fortius nigro-punctati. Long. ♂ 12 mm.

Queensland.

I have much pleasure in dedicating this fine insect to Mr. Ch. French. It is very distinct from *B. rugicollis*, Westw., the only species hitherto recorded from Australia.

### Sub-fam. EUSTHENINÆ.

### *Coptopelta*, n. gen.

Caput parvum, transversum, subtriangulare, lateribus sinuatum, jugis tylo longioribus et ante hunc per spatium longiusculum contiguis, ocellis inter se atque ab oculis subæque longe distantibus, antennis quinque-articulatis, articulo primo apicem capitis superante, secundo primo vix triplo longiore, tertio brevissimo, primo paullo breviore, quarto secundo subæquali, quinto quarto breviore, bucculis rotundatis, rostro coxas medias subattingente, articulo secundo apicalibus duobus unitis longiore, quarto tertio æquilongo. Pronotum basi subrectum, retrorsum haud productum, marginibus lateralibus anticis integris, reflexis, angulis lateralibus rotundatis, haud prominulis. Scutellum latitudine distincte longius, medium abdominis haud attingens, apice truncatum. Frena medium scutelli superantia. Mesosternum medio convexiusculum, nec carinatum nec sulcatum. Metasternum medio haud elevatum; ostia odorifica longiuscule auriculata. Corium scutello multo longius, margine apicali sinuatum; membrana areis basalibus destituta, venis longitudinalibus e vena transversa basali exeuntibus. Abdomen e latere visum retrorsum parum attenuatum, lateribus leviter explanatum, segmento secundo ventrali basi obtuse tuberculato, angulis apicalibus segmentorum (primo excepto) acute prominulis, sutura inter segmentum primum et secundum ventrale latera versus antrorsum curvata et

oblitterata, spiraculis leviter transversis, ante medium segmentorum sitis, e latere longissime distantibus, segmento sexto ventrali feminæ medio supra segmentum genitale libere nonnihil producto et obtuse bidentato. Pedes approximati, femoribus inermibus, tibiis femoribus brevioribus, supra sulcatis, tarsis triarticulatis.

This genus belongs to the group *Oncomerina* of Stål, and is well distinguished from the other genera of the group.

5. *Coptopelta crassiventris*, n. sp.

Subtus cornea, supra castanea, pronoto paullo pallidiore, marginibus lateralibus anticis pronoti et connexivo nigris, segmentis hujus macula media rufescente notatis, linea intralaterali pronoti, macula ad angulos basales scutelli hujusque linea longitudinali postmediana et apice luteis, exocorio subolivaceo, antennis pallide ferrugineis. Pronotum subrugosum et punctatum, marginibus lateralibus anticis levissime rotundatis. Scutellum punctatum. Hemelytra apicem abdominis paullum superantia, corio crebre subtiliter punctulato, membrana ænea. Abdomen lateribus subtiliter crenulatum, connexivo longitudinaliter striguloso, ventre læviusculo, latera versus ruguloso, sed limbo laterali explanato lævigato, spiraculis nigris. Pedes badii. Long. ♀ 24 mm.

Queensland.

It is possible that the colour of the upper side of the body is more greenish or olivaceous in the living insect.

N.B.—For an Australian genus of this group *Oncoscelis*, Westw., the name of which is preoccupied (Chevrolat, Coleoptera, 1834), I have proposed the name *Rhœcus* (Revue d'Entom., 1891, p. 214); but as also this name is preoccupied by Clark for a genus of Coleoptera (1860), I herewith substitute the name *Rhœcocoris* for Westwood's genus.

Fam. ACANTHOSOMIDÆ.

6. *Stauralia compuncta*, n. sp.

Ovalis, dilute subvirescenti-testacea, margine laterali capitis et prothoracis, parte basali pronoti, scutello (parte basali excepta), exocoris a basi ad medium, margine apicali corii lineaque intra-

marginali ventris carneo-rufis, pronoto, scutello, clavo ac corio parcius fortiter punctatis. Caput fere impunctatum, superne transversim rugulosum, antennis obscure testaceis, articulis duobus ultimis fuscis, articulo secundo primo longiore, tertio secundo paullo breviore, quarto secundo et quinto tertio subæquilongo. Pronotum lateribus subrectum, angulis lateralibus rotundalis, haud prominulis. Scutellum summo apice nigrum. Pectus parum punctatum. Hemelytra apicem abdominis paullum superantia, corio medium segmenti quinti connexivi superante, membrana vitrea. Abdomen dorso concolor, limbo externo connexivi rufescente, ventre inæqualiter concoloriter punctato, spina basali coxas anticas attingente, segmento quinto feminæ utrinque ad marginem apicalem impressione subopaca instructo. Pedes testacei. Long. ♀ 9·5 mm.

Victoria.

Much more strongly punctured than *T. chloracantha*, Dall., and differently coloured.

## Fam. Pyrrhocoridæ.

### *Syncrotus*, n. gen.

Corpus glabrum. Caput breve, crassum, apice pronoti latius, ante oculos sessiles fortiter declive, inter oculos et basin antennarum levissime angustatum, vertice convexo, bucculis marginem anticum oculorum et medium articuli primi rostri distinctissime superantibus, retrorsum humilioribus, postice coëuntibus, rostro basin ventris attingente, articulo primo marginem posticum oculorum haud attingente, secundo primo subæquilongo, tertio secundo perpaullo longiore, quarto tertio paullo breviore, articulo primo antennarum apicem capitis longissime superante, secundo et tertio unitis æquilongo tertio secundo multo breviore, quarto primo nonnihil breviore. Pronotum breve, transversum, lateribus laminato-reflexum, margine basali leviter rotundato, lobo antico et postico subæque longis, ambobus impunctatis, impressione aream anticam elevatam terminante antice et postice punctata, lateribus impunctata. Scutellum æquilaterum. Orificia distincta, Hemelytra completa, margine toto costali corii reflexo, sutura clavi et margine apicali corii subæque longis, hoc subrecto, angulo apicali subacuto, membrana area magna basali venas

simplices emittente instructa. Alæ hamo præditæ. Abdomen suturis ventralibus rectis instructum, margine apicali segmenti sexti ventralis feminæ medio sinuato. Femora antica quam media paullo breviora et crassiora, subtus inermia.

*Syncrotus* is not nearly allied to any described genus, but is to be placed between *Dindymus* and *Pyrrhopeplus*.

7. *Syncrotus circumscriptus*, n. sp.

Oblongo-ellipticus, nitidus, lævis, rufo-castaneus, segmentis quattuor primis ventris et pedibus luride testaceis, tibiis et tarsis infuscatis, antennis nigris, striga supera percurrente articuli harum primi et articulo ultimo apice excepto, margine toto pronoti, margine laterali corii et hujus fascia obliqua mox ante marginem apicalem, margine antico, laterali ac postico prosterni et postico metasterni, fascia apicali medio interrupta segmenti quarti ventris, basi et summo apice femorum apiceque tibiarum albidis, membrana nigra, margine pallescente, segmento sexto ventrali, margine apicali et laterali excepto, nigrescente. Caput subtus utrinque puncto impresso instructum, articulo primo antennarum leviter curvato. Pronotum lateribus fere in medio leviter sinuatum, lobo postico antico nonnihil latiore. Scutellum planiusculum. Hemelytra apicem abdominis vix attingentia, corio cum clavo sat dense punctato. Long. ♀ 9 mm.

Queensland.

8. *Dysdercus argillaceus*, n. sp.

Argillaceus, capite, area antica elevata pronoti, scutello, dorso abdominis areaque magna pleurarum fulvis vel pallide lurido-flavis, limbo apicali pronoti et prosterni, limbo postico pleurarum acetabulisque albis, fascia basali utrinque abbreviata segmentorum ventralium rufa, antennis fusco-nigris, articulo ultimo pallide lurido-testaceo rostro albo-testaceo, articulo ultimo nigro, membrana nigra, anguste albo-marginata, pedibus testaceis. Articuli tres primi antennarum apice incrassati, secundo primo multo breviore. Lobus posticus pronoti, corium cum clavo et pars posterior propleurarum nigro-punctata. Alæ fumatæ. Abdomen subtus lateribus remote concoloriter punctatum. Femora antica subtus prope apicem utrinque dente validiusculo et mox ante hunc dente minuto armata. Long. ♀ 13—13·5 mm.

Queensland.

Quite unlike anything hitherto known in the genus.

Fam. LYGÆIDÆ.

Sub-fam. GEOCORINÆ.

9. *Germalus victoriæ*, n. sp.

Oblongas, pallide flavo-testaceus, callo humerali pronoti fusco-nigro, ventre plerumque vitta rosea utrinque ornato. Caput impunctatum, rostro coxas medias attingente, summo apice articuli antennarum secundi tertiique et articulo quarto toto fuscis, articulo tertio secundo distincte breviore. Pronotum antrorsum levissime angustatum, remote nigro-punctulatum, anterius utrinque area impunctata præditum, lateribus rectis, margine basali rotundato. Scutellum callo curvato lævi basali vittam lævigatam subelevatam ad apicem emittente instructum, lateribus sat profunde fusco-punctatum. Pectus utrinque punctis parcis minutis nigris in vittam angustam ordinatis instructum. Hemelytra pellucida, extus leviter rotundata, clavo serie punctorum fuscorum completa et serie altera brevi ad commissuram instructo, corio serie punctorum completa ad suturam clavi et serie subcostali longius pone medium abrupta prædito, hac serie prope basin margini costali parallela, deinde ab hoc sensim divergente, disco corii præterea pone medium in dimidio externo parce punctulato, punctis fuscis. Abdomen dorso vittis duabus sinuosis nigris in segmento quinto conjunctis et ad apicem communiter continuatis signatum, segmento dorsali tertio et quarto et præterea macula parva media nigra notatis. Pedes minute et parcissime fusco-punctulati, interdum fere impunctati. Long. ♂ ♀ 4·4—4·7 mm.

Victoria.

The genus *Germalus*, Stål, was hitherto only known from Madagascar and the Phillipine Islands.

10. *Geocoris provisus*, n. sp.

Niger, capite subtus (excepta macula parva basali utrinque prope oculos) cum margine antico toto, orbita posteriore oculorum, vitta laterali pronoti, vitta media scutelli basin hujus haud attingente, angulis posticis metasterni limboque laterali abdominis

(ad marginem posticum segmentorum anguste fusco-interrupto) pallide flavis, impunctatis, margine laterali corii ferruginea, vitta anteriore corii medium hujus attingente albido-decolore. Caput basi pronoti perpaullo latius, dense punctulatum, margine antico inter oculos et antennas leviter rotundato, antennis testaceis, articulo secundo basi et quarto toto fuscis, tertio dimidio basali nigro. Pronotum transversum, parce fortiter punctatum, ante medium utrinque callo transverso lævi præditum, mox intra latera serie punctorum instructum, marginibus lateralibus e basi ad angulum posticum oculorum levissime convergentibus, deinde pone oculos, quos tangunt, valde convergentibus. Scutellum lateribus dense fortiter punctatum. Pectus sat dense et profunde punctulatum. Hemelytra apicem abdominis attingentia, clavo serie punctorum completa et serie postica interiore brevi instructo, corio in parte apicali exteriore parce fortius punctato, præterea seriebus duabus punctorum prædito, serie externa inter venam subcostalem et marginem costalem sita, serie interna clavo approximata, post medium ab hoc nonnihil divergente, apice extus curvata et secundum marginem apicalem continuata, inter partem posticam serisi internæ et clavi parce subconfuse punctato, membrana leviter infuscata, macula ad angulum basalem interiorem et venis albescentibus. Abdomen subtus læve. Pedes flavo-testacei. Long. ♀ 5 mm.

Victoria.

No species of the sub-family *Geocorinæ* was hitherto known from the Australian continent, but as the genus *Geocoris* is generally distributed throughout the world and is also found in New Caledonia, its occurrence in Australia is in no wise unexpected. I know a still undescribed Australian genus of *Geocorinæ*.

### Sub-fam. MYODOCHINÆ.

#### 11. *Clerada rufangula*, n. sp.

Crebre punctulata, nigra, angulis posticis prothoracis rufis, subtus, præsertim in medio segmentorum ventralium, piceo-tincta, annulo subbasali latiusculo articuli quarti antennarum albo. Caput subrhombeum, parte postoculari lateribus rotundata, oculo et ocello contiguis. Pronotum lateribus medio leviter sinuatum.

Hemelytra apicem abdominis nonnihil superantia. Pedes piceo-nigri. Long. ♀ 5·5 mm.

West Australia.

This is one of the most interesting insects that Mr. French has sent me. Of this genus a single species was known, *C. apicicornis*, Sign., with a vast geographical distribution, having been found in tropical America and Asia, and in the Mascarene and Seychelle Islands. From that species *C. rufangula* is easily distinguished by the very different colour-markings, and by having the head less elongated with the postocular part rounded on the sides and the ocelli contiguous to the eyes.

### Sub-fam. HETEROGASTRINÆ.

### *Trisecus*, n. gen.

Caput cum oculis apice pronoti latius, nonnihil exsertum, subæque longum ac latum, parte anteoculari longitudine fere duplo latiore, lateribus postocularibus parallelis, ocellis a basi capitis nonnihil remotis, inter se quam ab oculis plus quam duplo longius distantibus, tuberculis antenniferis valde declivibus, articulo primo antennarum paullo plus quam dimidio apicem capitis superante, secundo primo paullo plus quam dimidio longiore, tertio secundo paullo breviore, quarto tertio longitudine subæquali, bucculis brevissimis, rostro coxas medias attingente, articulo primo medium oculorum attingente, secundo primo longiore, apicem prosterni superante. Pronotum transversum, capite nonnihil longius, antrorsum fortiter angustatum, prope apicem fortius subrotundato-angustatum, annulo collari distincto instructum, basi late leviter sinuatum, paullo ante medium transversim, impressum, impressione latera haud attingente, marginibus lateralibus obtusis, convexis, lobo antico sat convexo. Scutellum subæquilaterum, dimidio apicali calloso, callo antice angulariter sinuato. Hemelytra apicem abdominis longius superantia, clavo vix punctato, sed lineis tribus impressis subtiliter punctulatis instructo, lineis duabus exterioribus ad suturam clavi approximatis, interstitio angusto convexo separatis, linea interna secundum marginem scutellarem et commissuram currente, a linea media intervallo lato plano disjuncta, commissura scutello longitudine subæquali, corio ad venas subtiliter punctato-striato,

ceteroquin impunctato, margine costali acuto, fere usque ad apicem leviter reflexo, margine apicali subrecto sutura clavi parum breviore, venis pone medium furcatis, cellulas tres magnas apicales rhomboidales formantibus, membrana cellulis duabus magnis basalibus venas simplices emittente prædita, sed inter has cellulas et angulum basalem interiorem venis duabus e basi membranæ exeuntibus venula transversa haud conjunctis instructa, exteriore longa, curvata, subdichotoma, interiore recta, simplice, margini interno membranæ valde approximata. Alæ hamo e vena subtensa emisso, basi alæ approximato instructæ. Abdomen subtus transversim valde convexum, segmento genitali maris magno, convexiusculo, recurvo, partem apicalem superiorem abdominis occupante, hamis copulatoriis longis, leviter curvatis, prope basin geniculatim inflexis. Pedes simplices, femoribus anticis parum incrassatis, inermibus, tibiis rectis, subtiliter et molliter pilosulis, articulo primo tarsorum posticorum articulis duobus ultimis unitis subæque longo.

This singular and aberrant genus seems to be allied to *Idiostolus*, Berg, from Basket Island (Cape Horn), but I think they cannot be identical. In his description of *Idiostolus* Professor Berg says that there is no *hamus* to the wings. But if in this genus the *hamus* has the same unusual place as in *Trisecus*, Professor Berg has possibly overlooked it.

12. *Trisecus pictus*, n. sp.

Oblongus, nitidus, læviusculus. Caput nigrum, substrigulosum, parcius pallido-sericeum, clypeo piceo, apice cum rostro testaceo, antennis pilosulis, nigris, articulo primo et basi secundi obscure testaceis, apice secundi et tertii albido-flavente. Pronotum læve, glabrum, basi quam apice fere duplo et dimidio latius, lateribus medio levissime subsinuatum, albido-flavens, linea impressa collare postice terminante et maculis duabus magnis subconfluentibus lobi antici fusco-piceis, macula media ovali et vitta utrinque laterali obliqua subcurvata lobi postici fusco-nigris, lobo antico postice in medio impresso, impressione carinula longitudinali divisa. Scutellum glabrum, dimidio basali transversim strigu-loso, nigro, dimidio apicali calloso lævi albido-flavente, linea tenui longitudinali pallide fusca partito. Pectus parce sericeum, fuscum, mesopleuris maxima parte et macula quadrata prope

angulos posticos metasterni nigris, margine antico, laterali ac postico prosterni, macula transversa apicali mesopleurarum, margine angusto laterali et postico metasterni acetabulioque omnibus albidis. Hemelytra glabra, corio et clavo albido-flaventibus, macula magna oblonga media interna clavi, macula oblonga media pone basin corii, macula hujus oblonga laterali mox pone medium, parte posteriore cellulæ apicalis externæ, macula ad basin cellulæ apicalis mediæ limboque intra venam cellulam apicalem internam extus terminantem fusco-nigris, membrana subhyalina, vitta media cum macula permagna apicali confluente maculaque elongata ad marginem interiorem fuscis. Alæ apicem versus leviter infuscatæ. Abdomen subtus læve, parce brevissime sericeum, ferrugineum, hic et illic præsertim lateribus infuscatum, segmento genitali maris medio leviter bi-impresso. Pedes graciliusculi, testacei, apice tibiarum et articulis duobus ultimis tarsorum fuscis, femoribus posticis paullo ante apicem leviter infuscatis. Long. ♂ sine membr. 5·7 mm.

Tasmania.

## Fam. Reduviidæ.

### Sub-fam. Harpactorinæ.

### 13. *Pristhesancus grassator*, n. sp.

Niger, ventre in piceum vergente, lobo antico pronoti, scutello, pectore (parte postica propleurarum excepta), coxis, trochanteribus, ima basi femorum, apice tibiarum tarsisque flavis, gula et lineola laterali anteoculari testaceis, ano flavescente. Caput pronoto paullo brevius, rostro piceo, articulationibus testaceis, articulo primo antennarum pronoto et scutello unitis nonnihil longiore, nigro, annulis duobus subobsoletis superne interruptis et apice testaceis, articulis tribus ultimis ferrugineis, secundo tertio fere dimidio longiore. Pronotum parce pilosum, lobo antico utrinque ante tubercula erecta cylindrica tuberculo parvo prædito, lateribus longitudinaliter bi-impresso. Scutellum parce longiuscule pilosum, tuberculo suberecto cylindrico apice integro. Corium parte apicali prolongata dilutius. Membrana et alæ hyalinæ. Abdomen lateribus rotundato-ampliatum, subtus subtiliter pulverulento-sericeum. Long. ♀ 21·5 mm.

Queensland.

14. *Havinthus obscurus*, n. sp.

Glabriusculus, niger, lobo postico pronoti, corio tibiisque fusco-testaceis, connexivo (apice segmentorum excepto) testaceo. Caput pronoto paullo longius, rostro piceo, basin capitis vix attingente, articulo primo parte anteoculari capitis plus quam duplo breviore, basin antennarum haud attingente, secundo primo duplo longiore, articulo primo antennarum capite nonnihil breviore. Pronotum fere in medio subconstrictum et transversim impressum, angulis apicalibus acute prominulis, lobo postico transversim ruguloso. Hemelytra (♀) abdomine nonnihil breviora. Femora granulata, antica praeterea subtus denticulis nonnullis armata; tibiæ anticæ quam femora sat multo breviores, posteriores femoribus longitudine subæquales. Long. ♀ 13·6 mm.

West Australia.

Somewhat resembling *H. pentatomus*, H. Sch., but at once distinguished by the much shorter basal joint of the rostrum, and the acutely produced fore angles of the pronotum.

15. *Havinthus rufovarius*, n. sp.

Breviter sat dense pilosus, niger, gula (excepta parte basali), parte anteoculari capitis (exceptis apice clypei et vitta laterali inter oculos et basin antennarum), maculis duabus magnis basalibus lobi antici pronoti, marginibus lateralibus posticis lobi postici pronoti, postscutello, basi clavi et corii hujusque fascia post medium, macula, magna marginali segmentorum tertii, quinti sextique abdominis solum apicem horum segmentorum liberum relinquente, fascia basali utrinque abbreviata segmentorum ventralium quinque primorum, macula magna media segmenti ventralis sexti totam longitudinem segmenti occupante et in segmentum genitale nonnihil extensa, trochanteribus, femoribus anticis (exceptis macula media supera et apice), parte basali et annulo subapicali femorum posteriorum, apice tibiarum tarsisque (apice excepto) laete rufis. Caput pronoto paullo longius, rostro apicem versus picescente, coxas anticas attingente, articulo primo parte anteoculari capitis paullulo breviore, secundo primo nonnihil longiore, articulo primo antennarum capiti æquilongo, articulo quarto lurido. Pronotum ante medium subconstrictum

et transversim impressum, angulis apicalibus subrotundatis, vix prominulis, lobo postico granulato-rugoso. Hemelytra (♀) apicem abdominis attingentia. Femora granulata; tibiæ anticæ apicem trochanterum attingentes, posteriores quam femora distincte longiores. Long. ♀ 19 mm.

West Australia.

The insect described by Reuter as a variety of *H. longiceps*, Stål, is possibly a variety of *rufovarius*, which is certainly distinct from *longiceps*.

## Sub-fam. ECTRICHODIINÆ.

### Nebriscus, n. gen.

Caput supra convexum, pone oculos mediocres subovales parum prominulos rotundatum, subtus utrinque pone oculos subtumidum, parte ocellos gerente vix elevata, articulo secundo rostri primo crassiore et dimidio longiore, antennis in medio inter oculos et apicem capitis insertis, articulo primo capiti subæquilongo, secundo primo nonnihil longiore, tertio primo triplo breviore (ceteri articuli desunt). Pronotum ante medium leviter constrictum et transversim impressum, angulis apicalibus breviter prominulis, marginibus lateralibus posticis depressis et subelevatis, margine basali recto, lobo antico linea impressa longitudinali diviso, hac linea impressionem transversam pronoti interrumpente et ibidem utrinque ruga terminata, deinde per partem plus quam dimidiam lobi postici continuata et in hoc dilatata, lobo postico antico latiore, intra angulos laterales rotundatos linea impressa longitudinali subtilissime crenulata instructo, ceteris impressionibus pronoti lævibus. Scutellum transversum, impressum, mucronibus apicalibus late distantibus. Mesosternum medio carinis duabus antrorsum convergentibus instructum. Metasternum pone medium transversim impressum. Cellulæ membranæ ambæ ad basin subæque latæ, cellula exteriore retrorsum dilatata, cellula interiore exteriore multo breviore, leviter curvata, ubique æque lata. Pedes antici leviter, posteriores late distantes, femoribus inermibus, anticis ceteris paullo crassioribus, tibiis femoribus subæquilongis, apice dilatatis, fossa spongiosa instructis, tarsis elongatis, articulo apicali basalibus duobus unitis subæquilongo.

This genus seems to be allied to *Antiopula*, Bergr., from Ceylon, but is distinguished by the structure of the rostrum and the antenuæ.

16. *Nebriscus pupus*, n. sp.

Puberulus, lævis, nitidiusculus, hemelytris (excepto margine costali corii a basi ad medium) opacis, niger, capite, lobo antico pronoti et rugis duabus impressionis transversæ hujus, scutello, parte apicali angulari corii (excepto ipso angulo), parte anteriore prosterni maculaque parva laterali metasterni sanguineis. Caput latitudine distincte longius, rostro fusco-testaceo, antennis nigris. Pronotum transversum, lobo antico sat convexo. Pedes nigri, coxis, trochanteribus, apice tibiarum femoribusque anticis basin versus piceis. Long. 6·7 mm.

Victoria.

Although the abdomen is wanting I do not hesitate to describe this new genus, as it is the first Australian representative of this sub-family, and as it is easily recognisable by the characters given above. It is the smallest insect hitherto known of this sub-family.

Sub-fam. STENOPODINÆ.

17. *Pygolampis frenchi*, n. sp.

Subglabra, nigra, hemelytris in fuscum vergentibus, spinulis capitis, ima basi rostri, spinis apicalibus prosterni, margine angusto acetabulorum, guttulis duabus externis (anteriore rotundata, posteriore oblonga) areæ exterioris membranæ, angulis basalibus segmentorum abdominalium dorsoque abdominis a basi ultra medium luride albidis. Caput apice medio spinuloso-prominulum, subtus utrinque et ante et post oculos spinulosum, articulo primo antennarum capite paullo longiore, obscure testaceo, fusco-variegato, subtus (apice excepto) granulis piligeris instructo, secundo primo haud dimidio longiore, tertio primo plus quam quadruplo breviore, quarto tertio fere duplo longiore. Pronotum capite distincte longius, lobo antico medio longitudinaliter sulcato, lobo postico carinis duabus antrorsum convergentibus instructo, latera versus longitudinaliter impresso. Pectus, imprimis mesosternum medio, brevissime sericeum. Hemelytra

(♂) apicem abdominis attingentia. Abdomen (♂) apice utrinque in lobum breviusculum triangularem productum. Pedes albido-testacei, femoribus apicem versus, basi et apice tibiarum, annulo submediano tibiarum anteriorum tarsisque nigris, femoribus anticis parum incrassatis, subtus in dimidio basali denticulis tribus perminutis distantibus armatis, femoribus posticis abdomine paullo brevioribus. Long. ♂ 12·5 mm.

Victoria.

Allied to *P. foeda*, Stål, but it is smaller and differently coloured, the first antennal joint is shorter and the anteocular part of the head is toothed beneath.

Tammerfors, Finland,

*December 1st*, 1894.

# MEETINGS OF THE ROYAL SOCIETY.

## 1894.

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## ANNUAL MEETING.

*Thursday, 8th March.*

The President (Professor Kernot) in the chair.

### Annual Report of the Council for the Year 1893.

The Council of the Royal Society herewith presents to the Members of the Society the Annual Report and Balance Sheet for the Year 1893.

The following Meetings were held, and Papers read during the Session:

March 9.—"Linguistic Points of Contact between the Aborigines of Australia and those of New Guinea," by Rev. John Mathew. "Notes on the Eocene Strata of the Bellarine Peninsula, with brief references to other deposits," by T. S. Hall, M.A., and G. B. Pritchard.

April 13.—"The Lizards Indigenous to Victoria," by A. H. S. Lucas, M.A., B.Sc., and C. Frost, F.L.S. (an interesting collection of Victorian Lizards was exhibited). "Further Notes on Australian Hydroids, with description of some New Species," by W. M. Bale, F.R.M.S. "Note on the Hatching of a Peripatus Egg," by Arthur Dendy, D.Sc. "A New Thermo-Electric Phenomenon," by W. Huey Steele, M.A.

May 11.—"Notes on the Saibai, Kaurarega and Gudang Languages, with remarks on Unsound Philological Methods," by Rev. Lorimer Fison, M.A.

June 8.—"Glaciation of the Western Highlands, Tasmania," by E. J. Dunn, (communicated by A. W. Howitt, F.G.S.) "Further Note on the Glacial Deposits of Bacchus Marsh," by C. G. W. Officer, B.Sc., and L. J. Balfour.

July 13.—"Notes on the Trawling Expedition at the Lakes Entrance," by T. S. Hart, M.A. "Defence of the Position—That there are Linguistic Points of Contact between the Aborigines of Australia and those of New Guinea, and corroboration of the theory that the Australian Aborigines entered the Continent on the New Guinea side," by Rev. John Mathew. "Some Statistics showing the extent of damage done to Members of the Medical Profession by the Abuse of Alcohol," by J. W. Barrett, M.D.

September 14.—"An Operculum from the Lilydale Limestone," by R. Etheridge, Junr., F.G.S. "Additional Notes on the Lilydale Limestone," by Rev. A. W. Cresswell. Mr. Elliott Cairns exhibited a number of Mineralogical specimens from Mount Wills, and made some remarks upon the occurrence of gold in granite in that locality. "Note from the Biological Laboratory of the Melbourne University, on a Crayfish with abnormally developed Appendages," by Arthur Dendy, D.Sc. "On the forthcoming meeting of the Australasian Association for the Advancement of Science," by E. F. J. Love, M.A.

October 12.—"Results of Observations with the Kater's Invariable Pendulums, made at the Melbourne Observatory, June-September, 1893," by Pietro Baracchi, F.R.A.S.

November 16.—"Observations on some new or little-known Land Planarians from Tasmania and South Australia," by Arthur Dendy, D.Sc. "Land Irrigation—Principles governing its economic application in warm climates," by Isaac Tipping, C.E.

December 14.—"Description of a New Half-Seconds Pendulum Apparatus for Gravity Observations," by R. L. J. Ellery, C.M.G., F.R.S., F.R.A.S. (The Apparatus referred to was exhibited). "Description of a New Chain Test Range at the Melbourne Observatory," by R. L. J. Ellery, C.M.G., F.R.S., F.R.A.S. "Preliminary Survey of Eucalyptus Oils of Victoria," by W. Percy Wilkinson. "The largest Australian Trilobite hitherto discovered," by R. Etheridge, Junr., F.G.S.

During the course of the year three Members, one Country Members and two Associates have been elected. Ten Members, two Country Members, and five Associates have reigned.

Your Council regrets to report the resignation, as one of the Honorary Secretaries and Member of the Council, of Dr. Arthur

Dendy, F.L.S., who leaves the colony to take up the position of Lecturer of Biology, at Canterbury College, Christchurch, in the University of New Zealand.

During his connection with the Society Dr. Dendy has acted in the capacity of Member of Council, Hon. Librarian, and during the past year as one of the Hon. Secretaries. In accepting Dr. Dendy's resignation the Council ordered the following resolution to be recorded in the minute book: "That Dr. Dendy's resignation of the position of one of the Secretaries of the Royal Society be accepted with great regret, and that a letter be written by the President conveying to him the Council's sincere appreciation of his great services both as Secretary and as Member of Council, and expressing the desire that, though removed to a distant colony, he will still continue his connection with the Society."

The Librarian reports as follows:—

"During the past twelve months the Library has steadily increased, 1212 books and parts of periodicals having been received. Very little expense has been incurred for binding, as only the Society's "Proceedings" and the Macleay Memorial volume have been bound. A new and handsome bookcase has been placed in the Library, to which it will form a much needed addition."

During the course of the year the following publications have been issued: "Proceedings," Vol. V. (new series), and Vol. VI. (new series).

The past year has been of necessity a very trying one to the Society in many ways, but at the same time it has had its satisfactory features, for notwithstanding an unavoidable falling off in the number of Members, the attendance at the monthly meetings has increased, and the papers and discussions have been fully up to the mark of those of previous years.

Whilst it may not at present be found possible to issue "Transactions," that of the "Proceedings" will continue as usual and the Council appeals confidently for support to the Members and Associates during the coming year.

## *The Honorary Treasurer in Account with the Royal Society of Victoria.*

**Dr.**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| To Balance from 28th February, 1893 ... | | | | £272 | 17 | 10 |
| ,, Government Grant— | | | | | | |
| Balance of Vote 1892-93 | £140 | 0 | 0 | | | |
| Instalments, 1893-94 ... | 190 | 0 | 0 | | | |
| | | | | 330 | 0 | 0 |
| ,, Entrance Fees ... ... ... ... | | | | 8 | 8 | 0 |
| ,, Subscriptions— | | | | | | |
| Members ... ... ... | £82 | 19 | 0 | | | |
| Country Members ... | 13 | 13 | 0 | | | |
| Associates... ... ... | 32 | 10 | 0 | | | |
| Arrears ... ... ... | 24 | 3 | 0 | | | |
| | | | | 153 | 5 | 0 |
| ,, Rent of Rooms ... ... ... ... | | | | 14 | 10 | 0 |
| ,, Sale of "Transactions" ... ... ... | | | | 3 | 3 | 6 |
| ,, Interest ... ... ... ... ... | | | | 24 | 15 | 0 |
| | | | | £806 | 19 | 4 |

**Cr.**

| | | | |
|---|---|---|---|
| By Printing and Stationery ... ... ... | £353 | 15 | 9 |
| ,, Rates ... ... ... ... ... ... | 3 | 10 | 0 |
| ,, Gas and Fuel ... ... ... ... | 7 | 15 | 8 |
| ,, Salary, &c., of Assistant Secretary ... | 100 | 0 | 0 |
| ,, Shorthand Records ... ... ... ... | 6 | 6 | 0 |
| ,, Hall-keeper's Allowance ... ... ... | 6 | 0 | 0 |
| ,, Collector's Commission ... ... ... | 10 | 14 | 0 |
| ,, Insurance ... ... ... ... ... | 4 | 0 | 0 |
| ,, Postages and Telegrams ... ... ... | 21 | 0 | 10 |
| ,, Repairs and Furniture ... ... ... | 25 | 19 | 0 |
| ,, Books and Periodicals ... ... ... | 8 | 1 | 0 |
| ,, Freight ... ... ... ... ... | 5 | 8 | 0 |
| ,, Refreshments .. ... ... ... | 5 | 5 | 5 |
| ,, Binding ... ... ... ... ... | 34 | 11 | 9 |
| ,, Gravity Survey Expenses .. .. ... | 11 | 16 | 6 |
| ,, Trawling Survey Expenses ... ... | 5 | 1 | 8 |
| ,, Incidentals ... ... ... ... ... | 8 | 15 | 5 |
| ,, Balance (28th February, 1894) ... ... | 188 | 18 | 4 |
| | £806 | 19 | 4 |

## PUBLISHING AND RESEARCH FUND.

| Dr. | £ | s. | d. | Cr. | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| To Fixed Deposit in Bank ... ... . | £300 | 0 | 0 | By Fixed Deposit in Bank of Australasia ... | £300 | 0 | 0 |
| „ Interest on same ... ... ... ... | 13 | 10 | 0 | „ Interest Transferred to General Account | 13 | 10 | 0 |
| | £313 | 10 | 0 | | £313 | 10 | 0 |

Compared with the Vouchers and Bank Pass-book and Cash-book, and found correct,

C. R. BLACKETT,
*Hon. Treasurer.*

ROBERT E. JOSEPH,
H. MOORS,
} *Auditors.*

*28th February*, 1894.

On the motion of Professor KERNOT, seconded by Mr. H. R. HOGG, the Annual Report and Balance Sheet were adopted.

### CHANGES IN THE LAWS.

The following changes were adopted on the proposal of Mr. E. J. WHITE, seconded by Mr. G. S. GRIFFITHS, that in Rule V. the words "two secretaries" be omitted, and the word "secretary" be inserted instead thereof, together with consequential changes in other laws.

### ELECTION OF OFFICE-BEARERS AND MEMBERS OF COUNCIL.

The following were elected:—President: Professor W. C. Kernot, M.A., C.E. Vice-Presidents: E. J. White, F.R.A.S., and H. K. Rusden, F.R.G.S. Hon. Treasurer: C. R. Blackett, F.C.S. Hon. Librarian: E. F. J. Love, M.A. Hon. Secretary: Professor W. Baldwin Spencer, M.A. Members of Council: R. L. J. Ellery, F.R.S.; G. S. Griffiths, F.R.G.S.; Professor Orme Masson, M.A., D.Sc.; H. Moors; Rev. E. H. Sugden, B.A., B.Sc.; T. W. Fowler, M.C.E.

The Annual Meeting having been declared at an end by the President, an Ordinary Meeting was then held.

Mr. Fryett was elected, and Messrs. A. J. Campbell and J. A. Atkinson were nominated as Associates.

Mr. E. F. J. LOVE read a paper on "Observations made at Sydney with Kater's Invariable Pendulums during January and February, 1894." A discussion ensued, in which Professor KERNOT and Mr. WHITE took part.

Mr. DUDLEY LE SOUEF read a paper on "Description of some Birds' Eggs from North Queensland."

Mr. G. B. PRITCHARD read a paper entitled "Notes on some Lancefield Graptolites."

Two papers by Professor SPENCER: (1) "Note on the presence of *Peripatus insignis* in Tasmania," and (2) "Preliminary Notes on some Tasmanian Earthworms," were taken as read.

Mr. Tipping's paper on "Land Irrigation" was postponed.

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*Thursday,* 12*th April.*

The President in the chair, and some twenty-six Members and Associates present.

Messrs. J. A. Atkinson and A. J. Campbell were elected Associates.

Mr. E. G. Hogg was nominated as a Member and Mr. Dudley Le Souef as an Associate.

An adjourned discussion on Mr. Love's paper on Kater's Pendulums, etc., was then held, in which the PRESIDENT and Messrs. ELLERY, BARRACHI, FOWLER and LOVE took part.

Mr. TIPPING then read a paper on "Land Irrigation—Principles governing its economic application." In the discussion which followed, the PRESIDENT and Messrs. ELLERY, FOWLER and EASTICK took part.

Two papers by Mr. T. S. Hall were, owing to lack of time, postponed.

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*Thursday, 10th May.*

The President in the chair and twenty-two Members and Associates present.

Mr. E. G. Hogg was elected a Member, and Mr. Dudley le Souef an Associate.

A resolution was passed on the proposal of Mr. ELLERY, seconded by Mr. LOVE, congratulating the Rev. Lorimer Fison on the honour done to him by receiving an invitation to be a guest of the British Association during the course of its meetings in Oxford.

Mr. T. S. HALL read a paper on the "Geology of Castlemaine, with a subdivision of the Lower Silurian Strata, and a list of Minerals." In the discussion which followed, Professor KERNOT and Messrs. HOGG, PRITCHARD, GRIFFITHS and SWEET took part.

A paper by Mr. W. Percy Wilkinson "On the Sugar Strength and Acidity of Victorian Musts," was taken as read.

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*Thursday, 14th June.*

The President in the chair.

Mr. M. J. Fardy was balloted for and elected an Associate.

Dr. J. W. BARRETT gave a Demonstration explanatory of the Modern Theories of the Coagulation of the Blood, and the action of Snake Venom on the Blood.

A paper was read by Messrs. Officer, Balfour and Hogg, on "Geological Notes on the Country between Strahan and Lake St. Clair, Tasmania." In the discussion of the paper Messrs. Griffiths, Hall, Pritchard and the President took part.

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*Thursday, 12th July.*

The President in the chair and some twenty Members and Associates present.

Mr. A. E. Kitson was nominated as an Associate.

Professor Kernot read a paper on "The Best Form for a Balance Beam."

Dr. MacGillivray read a paper on "The Australian Species of Amathia."

A paper was communicated by Mr. R. H. Mathews, on "Aboriginal Rock Paintings and Carvings in New South Wales." In the discussion of the paper the President and Messrs. Mathews, Dunn, Hall, McAlpine and Lucas took part, and a letter on the subject was read from Mr. A. W. Howitt.

Mr. G. B. Pritchard read a note on "The Occurrence of Fossil Bones at Werribee."

Mr. McAlpine and Mr. J. G. O. Tepper read a paper on "A New Stone-making Fungus—Laccocephalum basilapiloides."

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*Thursday, 9th August.*

The President in the chair and some twenty-two Members and Associates present.

Mr. A. E. Kitson was elected an Associate.

Dr. Gardner was nominated as a Member, and Mr. W. H. Ferguson as an Associate.

Mr. McAlpine and Mr. W. H. F. Hill read a paper on "The Entomogenous Fungi of Victoria, Part I.—Isaria oncopteræ."

Mr. Rusden read a paper on "Cremation and Burial in relation to Death Certification," and in a discussion of the same the President and Messrs. Ellery, White, Tipping and Dr. Jamieson took part.

Professor Lyle demonstrated Joly's Melting Point Apparatus, and Joly's Steam Calorimetre.

Mr. Ellery demonstrated a new Micrometric Machine, to be used in the measurement of the astrograph star plates, and in determining the size of the star discs for the estimation of stellar magnitudes.

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*Thursday, 13th September*

Professor Kernot in the chair, and twenty-eight Members and Associates present.

Dr. Gardner was elected a Member, and Mr. W. H. Ferguson an Associate.

Messrs. W. H. F. Hill, J. Shephard, and T. S. Hart, M.A., were nominated as Associates.

Dr. Jamieson read a paper on "An Attempt to Estimate the Population of Melbourne at the present time." In the ensuing discussion Messrs. Rusden, White, Hogg, and Spencer took part.

Messrs. T. S. Hall and G. B. Pritchard read a paper on "The Older Tertiaries of Maude, with an Indication of the Sequence of the Eocene Beds of Victoria."

Mr. Pritchard communicated a paper by Mr. C. Hedley, on "A Molluscan Genus new to, and another forgotten from Australia."

Mr. A. Foster Smith exhibited a new Automatic Recording Compass. A discussion was held, and taken part in by Messrs. Ellery, Love, Yeates and the President.

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*Thursday, 8th November.*

The President in the chair and twenty-six Members and Associates present.

The following Committees were elected :

(1) *Antarctic Committee*—Messrs. Kernot, Griffiths, Ellery and Rusden.

(2) *Port Phillip Biological* — Messrs. J. B. Wilson, McGillivray, Hall, Pritchard and Spencer (*Sec.*)

(3) *House Committee*—Messrs. Kernot, Masson, Blackett and Rusden.

(4) *Gravity Survey*—Messrs. Ellery, White, Masson, Lyle, Baracchi and Love (*Sec.*)

(5) *Printing*—Mr. Ellery, the Hon. Treasurer and Hon. Secretary.

Mr. W. Percy Wilkinson was nominated as a Member.

Messrs. Lidgey, T. S. Hart, Shephard and Hill were elected as Members.

Mr. G. B. PRITCHARD read a paper on "Contributions to the Palæontology of the Older Tertiary of Victoria—Lamellibranchs. Part I."

Mr. A. J. CAMPBELL read papers on (1) "Notes on Birds;" (2) "The Gymnorhinæ or Australian Magpies, with a description of a New Species." A discussion ensued, in which Messrs. WHITE, RUSDEN, LE SOUEF, SPENCER and DUNN took part.

Professor SPENCER read a paper on "Preliminary Notes on certain Marsupials from Central Australia," and a paper by Mr. MCALPINE on "Australian Fungi" was taken as read.

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*Thursday,* 15*th December.*

The President in the chair.

Messrs. Moors and Gilbert were elected Auditors.

Dr. MACGILLIVRAY nominated for re-election the retiring Officers and Members of Council.

Mr. W. Percy Wilkinson was elected a member, and Mr. C. A. Robinson an Associate.

Mr. W. R. Bennetts, Junr., was nominated an Associate.

Mr. A. SUTHERLAND read a paper on "Some Quantitative Laws in Incubation and Gestation."

Messrs. A. H. S. LUCAS and C. FROST read a paper on a "Preliminary account of certain Lizards from Central Australia."

Dr. MACGILLIVRAY read a paper on "A Monograph of the Tertiary Polyzoa of Victoria."

Professor A. DENDY contributed a paper entitled: "Catalogue of Non-Calcareous Sponges collected by J. Bracebridge Wilson, Esq., in the neighbourhood of Port Phillip Heads. Part I."

It was announced that Dr. MacGillivray's paper "A Monograph of the Tertiary Polyzoa of Victoria," would be published in the "Transactions" of the Society.

## Report of the Gravity Survey Committee.

Since the date of the last Report, good progress has been made. Mr. Love has swung the Kater Pendulums at Sydney, and his results, combined with those of Mr. Baracchi for Melbourne, show that the difference between the values of gravity at the two places is very nearly as found by Lieut. Elblein of the Austrian Survey. Mr. Ellery has completed his Apparatus, in which Half-Seconds Pendulums are employed, and the work of determining the constants for them is partly done. Mr. Love has now taken them home to swing at Kew Observatory. It is hoped that the field work of the Survey may be commenced about the end of next year, but much still remains to be done in the way of testing the Apparatus, and it is impossible at present to speak positively on this point.

The Committee asks for re-appointment; and that the unexpended balance (£8 18s.) of the original grant may be placed at its disposal.

E. F. J. Love, *Secretary.*

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## Report of the House Committee.

Your Committee have to report that during the past year there has been very little for them to do. The house and grounds have been attended to. A new bell has been placed in the caretaker's house, which was urgently needed; the paths in the garden have been cleaned and a quantity of crude arsenic applied to destroy the weeds and prevent their growth; this was done without expense to your Committee.

C. R. Blackett, *Convener.*

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## Report of the Port Phillip Biological Committee.

Your Committee has to report that the work of determining the large collection of specimens collected by Mr. J. Bracebridge Wilson is slowly progressing.

The most important publication of the year, dealing with this, is Dr. Dendy's "Catalogue of Non-Calcareous Sponges, Part I.", which appears in this issue.

Mr. Hedley's paper on "A Molluscan Genus new to, and one forgotten from, Australia," describes specimens procured by Mr. Wilson.

Mr. G. B. Pritchard has examined the great majority of examples of Mollusca in the Port Phillip collection, and a description of these will appear in a general catalogue of Victorian marine Mollusca, which Mr. Pritchard is now engaged upon.

The specimens of "Chitonidæ" are now being examined by Mr. Sykes in England, and during the course of the coming year it is hoped that a descriptive catalogue of these will be issued.

Whilst in England Professor Spencer interviewed the specialists who are now engaged in describing the Tunicata, Polychæta, and Pycnogonida, and it is hoped that the results of their work will also be published during the course of the coming year.

W. BALDWIN SPENCER, *Secretary.*

# LAWS.

*Amended to December, 1894.*

I. The Society shall be called "The Royal Society of Victoria." **Name.**

II. The Royal Society of Victoria is founded for the advancement of science, literature and art, with especial reference to the development of the resources of the country. **Objects.**

III. The Society shall consist of Ordinary Members residing within ten miles of Melbourne; Country Members residing beyond that distance; Life Members (Law XXV.), Honorary Members (Law XXIV.), Corresponding Members (Law LII.), and Associates (Laws XXV., XXVI., and LIII.), all of whom shall be elected by ballot. **Members and Associates.**

IV. His Excellency the Governor of Victoria, for the time being, shall be invited to accept the office of Patron of the Society. **Patron.**

V. There shall be a President, and Two Vice-Presidents, who, with twelve other Members, and the following Honorary Officers, viz., Treasurer, Librarian, and Secretary of the Society, shall constitute the Council. **Officers.**

VI. The Council shall have the management of the affairs of the Society. **Management.**

VII. The Ordinary Meetings of the Society shall be held once in every month during the Session, from March to December inclusive, on days fixed and subject to alteration by the Council with due notice. **Ordinary Meetings.**

VIII. In the second week in March, there shall be an Annual General Meeting, to receive the report of the Council, and elect the Officers of the Society for the ensuing year. **Annual General Meetings.**

Retirement of Officers.

IX. All Office-bearers and Members of Council except the six junior or last elected Members, shall retire from office at the Annual General Meeting in March. Should a senior Member's seat become vacant in the course of the year, it shall be held by his successor (under Law XIII.), as a senior Member, who shall retire at the next Annual General Meeting. The names of such retiring Officers are to be announced at the Ordinary Meeting in December. The Officers and Members of Council so retiring shall be eligible for the same or any other office then vacant.

Election of Officers.

X. The President, Vice-Presidents, Treasurer, Secretary, and Librarian shall be separately elected by ballot (should such be demanded), in the above-named order, and the six vacancies in the Council shall then be filled up together by ballot at the General Meeting in March. Those members only shall be eligible for any office who have been proposed and seconded at the Ordinary Meeting in December, or by letter addressed to the Secretary, and received by him before the 1st March, to be laid before the Council Meeting next before the Annual Meeting in March. The nomination to any one office shall be held a nomination to any office, the election to which is to be subsequently held. No ballot shall take place at any meeting unless ten members be present.

Votes required.

Members in arrear.

XI. No member, whose subscription is in arrear, shall take part in the election of Officers or other business of the meeting.

Address by the President.

XII. An address shall be delivered by the President of the Society at either a Dinner, Conversazione, or extra meeting of the Society, as the Council may determine in each year.

Vacancies.

XIII. If any vacancy occur among the Officers, notice thereof shall be inserted in the summons for the next meeting of the Society, and the vacancy shall be then filled up by ballot.

Duties of President.

XIV. The President shall take the chair at all meetings of the Society and of the Council, and shall regulate and

keep order in all their proceedings; he shall state questions and propositions to the meeting, and report the result of ballots, and carry into effect the regulations of the Society. In the absence of the President, the chair shall be taken by one of the Vice-Presidents, Treasurer, or Ordinary Member of Council, in order of seniority.

XV. The Treasurer may, immediately after his election, appoint a Collector (to act during pleasure), subject to the approval of the Council at its next meeting. The duty of the Collector shall be to issue the Treasurer's notices, and collect subscriptions. The Treasurer shall receive all moneys paid to the Society, and shall deposit the same before the end of each month in the bank approved by the Council, to the credit of an account opened in the name of the Royal Society of Victoria. The Treasurer shall make all payments ordered by the Council on receiving a written authority from the chairman of the meeting. All cheques shall be signed by himself, and countersigned by the Secretary. No payments shall be made except by cheque, and on the authority of the Council. He shall keep a detailed account of all receipts and expenditure, present a report of the same at each Council meeting, and prepare a balance-sheet to be laid before the Council, and included in its Annual Report. He shall also produce his books whenever called upon to do so by the Council.

Duties of Treasurer.

XVI. The Secretary shall conduct the correspondence of the Society and of the Council, attend all meetings of the Society and of the Council, take minutes of of their proceedings, and enter them in the proper books. He shall inscribe the names and addresses of all Members and Associates in a book to be kept for that purpose, from which no name shall be erased except by order of the Council. He shall issue notices of all meetings of the Society and of the Council, and shall have the custody of all papers of the Society, and, under the direction of the Council, superintend the printing of the "Proceedings" and "Transactions" of the Society.

Duties of Secretary.

**Meetings of Council.**

XVII. The Council shall meet on any day within one week before every Ordinary Meeting of the Society. Notice of such meeting shall be sent to every member at least two days previously. No business shall be transacted at any meeting of the Council unless five members be present. Any member of Council absenting himself from three consecutive meetings of Council, without satisfactory explanation in writing, shall be considered to have vacated his office, and the election of a member to fill his place shall be proceeded with at the next Ordinary Meeting of Members, in accordance with Law XIII.

**Quorum.**

**Special Meetings of Council.**

XVIII. The Secretary shall call a Special Meeting of Council on the authority of the President or of three Members of the Council. The notice of such meeting shall specify the object for which it is called, and no other business shall be entertained.

**Special General Meetings.**

XIX. The Council shall call a Special Meeting of the Society, on receiving a requisition in writing signed by twenty-four Members of the Society, specifying the purpose for which the meeting is required, or upon a resolution of its own. No other business shall be entertained at such meeting. Notice of such meeting, and the purpose for which it is summoned, shall be sent to every Member at least ten days before the meeting.

**Annual Report.**

**Auditors.**

XX. The Council shall annually prepare a Report of the Proceedings of the Society during the past year, embodying the Balance Sheet, duly audited by two Auditors, to be appointed for the year at the Ordinary Meeting in December, exhibiting a statement of the present position of the Society. This Report shall be laid before the Society at the Annual Meeting in March. No paper shall be read at that meeting.

**Expulsion of Members.**

XXI. If it shall come to the knowledge of the Council that the conduct of an Officer, a Member, or an Associate is injurious to the interest of the Society, and if two-thirds of the Council present shall be satisfied, after opportunity of defence has been afforded to him, that such is the case,

it may call upon him to resign, and shall have the power to expel him from the Society, or remove him from any office therein at its discretion. In every case, all proceedings shall be entered upon the minutes.

**Election of Members and Associates.**

XXII. Every candidate for election as Member or as Associate shall be proposed and seconded by Members of the Society. The name, the address, and the occupation of every candidate, with the names of his proposer and of his seconder, shall be communicated in writing to the Secretary, and shall be read at a meeting of Council, and also at the following meeting of the Society, and the ballot shall take place at the next following Ordinary Meeting of the Society. The assent of at least five-sixths of the number voting shall be requisite for the admission of a candidate.

**Votes required to admit.**

**Members shall sign laws.**

XXIII. Every new Member or Associate shall receive due notice of his election, and be supplied with a copy of the obligation,* together with a copy of the Laws of the Society. He shall not be entitled to enjoy any privilege of the Society, nor shall his name be printed in the List of Members, until he shall have paid his admission fee and first annual subscription, and have returned to the Secretary the obligation signed by himself. He shall at the first meeting of the Society at which he is present, sign a duplicate of the obligation in the Book of the Laws of the Society, after which he shall be introduced to the Society by the Chairman. No Member or Associate shall be at liberty to withdraw from the Society without previously giving notice in writing to the Secretary of his intention to withdraw, and returning all books or other property of the Society in his possession. Members and Associates will be considered liable for the payment of all

**Conditions of Resignation.**

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* The obligation referred to is as follows :—

ROYAL SOCIETY OF VICTORIA.

I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the Royal Society of Victoria, and to observe its laws, as long as I shall remain a Member or Associate thereof.

(Signed)

Address

Date

subscriptions due from them up to the date at which they give written notice of their intention to withdraw from the Society.

Honorary Members.

XXIV. Gentlemen not resident in Victoria, who are distinguished for their attainments in science, literature, or art, may be proposed for election as Honorary Members, on the recommendation of an absolute majority of the Council. The election shall be conducted in the same manner as that of Ordinary Members, but nine-tenths of the votes must be in favour of the candidate.

Subscriptions.

XXV. Ordinary Members of the Society shall pay two guineas annually, Country Members and Associates shall pay one guinea annually. Those elected after the first of July shall pay only half of the subscription for the current year. Ordinary Members may compound for all annual subscriptions of the current and future years by paying £21; and Country Members may compound in a like manner by paying £10 10s. Any Country Member having compounded for his subscription, and coming to reside within ten miles of Melbourne, must pay either the balance £10 10s. of the Ordinary Member's composition, or one guinea annually while he resides within ten miles of Melbourne. The subscriptions shall be due on the 1st of January in every year. At the commencement of each year there shall be hung up in the Hall of the Society a list of all Members and Associates, upon which the payment of their subscription as made shall be entered. During July, notice shall be sent to all Members and Associates still in arrears. At the end of each year, a list of those who have not paid their subscriptions shall be prepared, to be considered and dealt with by the Council.

Life Membership.

Entrance fees, etc.

XXVI. Newly-elected Ordinary and Country Members shall pay an entrance fee of two guineas, in addition to the subscription for the current year. Honorary Members, Corresponding Members and Associates shall not be required to pay any entrance fee. If the entrance fee and subscription be not paid with one month of the notification of election, a second notice shall be sent, and if payment

be not made within one month from the second notice, the election shall be void. Associates, on seeking election as Ordinary or Country Members, shall comply with all the forms prescribed for the election of Members, and shall pay the entrance fee prescribed above of Ordinary or Country Members respectively.

XXVII. At the Ordinary Meetings of the Society the chair shall be taken punctually at eight o'clock, and no new business shall be taken after ten o'clock. **Duration of Meetings.**

XXVIII. At the Ordinary Meetings business shall be transacted in the following order, unless it be specially decided otherwise by the Chairman:— **Order and mode of conducting the business.**

Minutes of the preceding meeting to be read, amended if incorrect, and confirmed.

New Members and Associates to enrol their names, and be introduced.

Ballot for the election of new Members or Associates.

Vacancies among Officers, if any, to be filled up.

Business arising out of the minutes.

Communications from the Council.

Presents to be laid on the table, and acknowledged.

Motions, of which notice has been given, to be considered.

Notice of motion for the next meeting to be given in and read by the Secretary.

Papers to be read.

XXIX. No stranger shall speak at a meeting of the Society unless specially invited to do so by the Chairman. **Strangers.**

XXX. Every paper before being read at any meeting must be submitted to the Council. **Papers to be first laid before Council.**

XXXI. The Council may call additional meetings whenever it may deem it necessary to do so. **Additional Meetings.**

XXXII. Every Member may introduce two visitors to the meetings of the Society by orders signed by himself. **Visitors.**

Members may read papers.

XXXIII. Members and Associates shall have the privilege of reading before the Society account of experiments, observations, and researches conducted by themselves, or original papers, on subjects within the scope of the Society, or descriptions of recent discoveries, or inventions of general scientific interest. No vote of thanks to any Member or Associate for his paper shall be proposed.

Or depute other Members.

XXXIV. If a Member or Associate be unable to attend for the purpose of reading his paper, he may delegate to any Member of the Society the reading thereof, and his right of reply.

Members must give notice of their papers.

XXXV. Any Member or Associate desirous of reading a paper, shall give in writing, to the Secretary, ten days before the meeting at which he desires it to be read, its title and the time its reading will occupy.

Papers by Strangers.

XXXVI. The Council may for any special reason permit a paper such as is described in Law XXXIII., not written by a member of the Society, to be read by the Secretary or a Member.

Papers belong to the Society.

XXXVII. Every paper read before the Society shall be the property thereof, and immediately after it has been read shall be delivered to the Secretary, and shall remain in his custody.

Papers must be original.

XXXVIII. No paper shall be read before the Society or published in the "Transactions" unless approved of by the Council, and unless it consist mainly of original matter as regards the facts or the theories enunciated.

Council may refer papers to Members.

XXXIX. The Council may refer any paper to any Member or Members of the Society, to report upon the desirability of printing it.

Rejected papers to be returned.

XL. Should the Council decide not to publish a paper, it shall be at once returned to the author.

Members may have copies of their papers.

XLI. The author of any paper which the Council has decided to publish in the "Proceedings" or "Transactions" may have fifty copies of his paper on giving notice of his

wish, in writing, to the Secretary, and any further number on paying the extra cost thereof.

XLII. Every Member and Associate whose subscription is not in arrear, and every Honorary and Corresponding Member, is entitled to receive one copy of the "Proceedings" and "Transactions" of the Society as published. Newly-elected Members shall, on payment of their entrance fee and subscription, receive a copy of the volume of the "Proceedings" and "Transactions" last published. **Members and Associates to have "Transactions."**

XLIII. Every book, pamphlet, model, plan, drawing, specimen, preparation, or collection presented to or purchased by the Society, shall be kept in the house of the Society. **Property.**

XLIV. The Library shall be open to Members and Associates of the Society, and the public, at such times and under such regulations as the Council may deem fit. **Library.**

XLV. The legal ownership of the property of the Society is vested in the President, the Vice-Presidents, and the Treasurer for the time being, in trust for the use of the Society; but the Council shall have full control over the expenditure of the funds and management of the property of the Society. **Legal ownership of property.**

XLVI. Every Committee appointed by the Society shall at its first meeting elect a Chairman, who shall subsequently convene the Committee and bring up its report. He shall also obtain from the Treasurer such grants as may have been voted for the purposes of the Committee. **Committees elect Chairman.**

XLVII. All Committees and individuals to whom any work has been assigned by the Society shall present to the Council, not later than the 1st of November in each year, a report of the progress which has been made; and, in cases where grants of money for scientific purposes have been entrusted to them, a statement of the sums which have been expended, and the balance of each grant which remains unexpended. Every Committee shall cease to exist at the November meeting, unless then re-appointed. **Report before November 1st.**

Grants expire.

XLVIII. Grants of pecuniary aid for scientific purposes from the funds of the Society shall expire on the 1st of March next following, unless it shall appear by a report that the recommendations on which they were granted have been acted on, or a continuation of them be ordered by the Council.

Personal expenses not to be paid.

XLIX. In grants of money to Committees and individuals, the Society shall not pay any personal expenses which may be incurred by the Members.

Alterations of laws.

L. No new law, or alteration or repeal of an existing law, shall be made except at the Annual General Meeting in March, or at a Special General Meeting summoned for the purpose, as provided in Law XIX., and in pursuance of notice given at the preceding Ordinary Meeting of the Society.

Cases not provided for.

LI. Should any circumstance arise not provided for in these Laws, the Council is empowered to act as may seem to be best for the interests of the Society.

Corresponding Members.

LII. The Council shall have power to propose gentlemen not resident in Victoria, for election in the same manner as Ordinary Members, as Corresponding Members of the Society. The Corresponding Members shall contribute to the Society papers which may be received as those of Ordinary Members, and shall in return be entitled to receive copies of the Society's publications.

Privileges of Associates.

LIII. Associates shall have the privileges of Members in respect to the Society's publications, and at the Ordinary Meetings, with the exception, that they shall not have the power of voting; they shall also not be eligible as Officers of the Society.

# The Royal Society of Victoria.

## LIST OF MEMBERS,

*WITH THEIR YEAR OF JOINING.*

### Patron.

| | |
|---|---|
| Hopetoun, His Excellency the Right Honourable John Adrian Louis Hope, G.C.M.G., Seventh Earl of | 1890 |

### Honorary Members.

| | |
|---|---|
| Agnew, Hon. J. W., M.E.C., M.D., Hobart, Tasmania ... | 1888 |
| Bancroft, J., Esq., M.D., Brisbane, Queensland ... | 1888 |
| Clarke, Colonel Sir Andrew, K.C.M.G., C.B., C.I.E., (*President*, 1855 *to* 1857), London. | 1854 |
| Forrest, Hon. J., C.M.G., Surveyor-General, West Australia. | 1888 |
| Hector, Sir James, K.C.M.G., M.D., F.R.S., Wellington, N.Z. | 1888 |
| Liversidge, Professor A., F.R.S., University, Sydney, N.S.W. | 1892 |
| Neumeyer, Professor George, Ph.D., Hamburg, Germany | 1857 |
| Russell, H. C., Esq., F.R.S., F.R.A.S., Observatory, Sydney, N.S.W. | 1888 |
| Scott, Rev. W., M.A., Kurrajong Heights, N.S.W. ... | 1855 |
| Todd, Sir Charles, K.C.M.G., F.R.A.S., Adelaide, S.A. ... | 1856 |
| Verbeek, Dr. R. D. M., Buitenzorg, Batavia, Java ... | 1886 |

### Life Members.

| | |
|---|---|
| Barkly, His Excellency Sir Henry, G.C.M.G., K.C.B. (*President*, 1860 *to* 1863), Carlton Club, London. | 1857 |
| Bosisto, Joseph, Esq., C.M.G., M.L.A., Richmond ... | 1857 |
| Butters, J. S., Esq., Empire Buildings, Collins-street West | 1860 |

Eaton, H. F., Esq., Treasury, Melbourne ... ... 1857
Elliott, J. S., Esq., Elsternwick ... ... ... 1856
Elliott, Sizar, Esq., Asling-street, Brighton Beach ... 1856

Fowler, Thomas W., Esq., 317 Collins-street ... ... 1877

Gibbons, Sydney W., Esq., F.C.S., c/o Mr. Lewis, 341 Bourke-street. 1854
Gilbert, J. E., Esq., Money Order Office, G.P.O., Melbourne 1872

Howitt, Edward, Esq., Rathmines-road, Auburn ... 1868

Love, E. F. J., Esq., M.A., Queen's College, University 1888

Mueller, Baron F. von, K.C.M.G., M.D., Ph.D., F.R.S. (*President*, 1859), Arnold-street, South Yarra. 1854

Nicholas, William, Esq., F.G.S., 5 Auburn Grove, Camberwell. 1864

Rusden, H. K., Esq., Ockley, corner of North-road and Hotham-street, Brighton. 1866

Selby, G. W., Esq., 99 Queen-street, Melbourne ... 1881

White, E. J., Esq., F.R.A.S., Observatory, Melbourne ... 1868
Wilson, Sir Samuel, Knt., Euildonne, Burrembeet ... 1878

## Ordinary Members.

Allan, Alex. C., Esq., Sixth Floor, Colonial Mutual Chambers, Market-street. 1867
Archer, W. H., Esq., J.P., F.L.S., F.I.A., Alverno, Grace Park, Hawthorn. 1887

Bage, William, Esq., M.I.C.E., 349 Collins-street ... 1888
Balfour, Lewis J., Esq., Tyalla, Toorak ... ... 1892
Barnes, Benjamin, Esq., Queen's Terrace, South Melbourne 1866
Baracchi, Pietro, Esq., F.R.A.S., Observatory, Melbourne 1887
Barrett, Dr. J. W., 34 Collins-street East ... ... 1891
Bevan, Rev. L. D., LL.D., D.D., Congregational Hall, Russell-street. 1889
Beckx, Gustave, Esq., Queen's Place, St. Kilda-road ... 1880
Blackett, C. R., Esq., J.P., F.C.S., Charlesfort, Tennyson-street, South St. Kilda. 1879

Campbell, F. A., Esq., C.E., Working Men's College, Latrobe-street. 1879
Candler, Samuel Curtis, Esq., Melbourne Club ... 1888
Cherry, T., Esq., M.D., University, Melbourne ... 1893
Cohen, Joseph B., Esq., A.R.I.B.A., Public Works Department, Melbourne. 1877
Coane, J. M., Esq., C.E., Fourth Floor, Prell's Buildings, Queen-street. 1888

Danks, John, Esq., 391 Bourke-street West ... ... 1871
Davidson, Wm., Esq., C.E., Inspector-General of Public Works, Melbourne. 1880
Dennant, John, Esq., F.G.S., F.C.S., Russell-street, Camberwell. 1886
Dunn, Frederick, Esq., 306 Little Flinders-street ... 1880
Dunn, E. J., Esq., F.G.S., 77 Packington-street, Kew ... 1893

Eastick, J., Esq., The Australian Sugar Refinery Company Limited, Port Melbourne. 1893
Ellery, R. L. J., Esq., C.M.G., F.R.S., F.R.A.S., (*President*, 1866 *to* 1885), Observatory, Melbourne. 1856

Fox, W., Esq., 28 Robe-street, St. Kilda ... ... 1887
Fryett, A. G., Esq., Esplanade Hotel, St. Kilda ... 1893

Gardner, Wm., Esq., M.R.C.S., 5 Collins-street East ... 1894
Goldstein, J. R. Y., Esq., Office of Titles, Melbourne ... 1879
Gotch, J. S., Esq., 109 Albert-street, East Melbourne ... 1881
Griffiths, G. S., Esq., F.R.G.S., 313 Collins-street ... 1883

Hake, C. N., Esq., F.C.S., Melbourne Club, Melbourne ... 1890
Hall, T. S., Esq., M.A., University, Melbourne ... 1890
Hart, Ludovico, Esq., 10 Affleck-street, South Yarra ... 1883
Heffernan, E. B., Esq., M.D., 10 Brunswick-st., Fitzroy... 1879
Hogg, H. R., Esq., 16 Market Buildings, Flinders-lane W. 1890
Hogg, E. G., Esq., Trinity College, University, Melbourne 1894
Howitt, A. W., Esq., P.M., F.G.S., Secretary Mining Department, Melbourne. 1877

Jäger, Ernest, Esq., North-street, Ascot Vale ... ... 1889
James, E. M., Esq., M.R.C.S., 71 Spring-street, Melbourne 1883
Jamieson, James, Esq., M.D., 56 Collins-street East ... 1877
Joseph, R. E., Esq., Electric Light Company, Sandridge-Road, Melbourne. 1877

Kernot, Professor W. C., M.A., C.E. (*President*, 1885 *to* 1894), University, Melbourne. 1870

Lucas, A. H. S., Esq., M.A., B.Sc., F.L.S., Newington College, Sydney, N.S.W. 1885
Lyle, Professor T. R., M.A., University, Melbourne ... 1889
Lynch, William, Esq., St. James' Buildings, William-street, Melbourne. 1868

McCoy, Professor Sir F., K.C.M.G., D.Sc., F.R.S. (*President*, 1864), University, Melbourne. 1855
McAlpine, D., Esq., 10 Armadale-road, Armadale ... 1889
Main, Thomas, Esq., City Surveyor's Offices, Melbourne 1881
Masson, Professor Orme, M.A., D.Sc., University, Melbourne 1887
Mathew, Rev. John, Coburg ... ... ... 1890
Moerlin, C., Esq., Claud Villa, Armadale-road, Armadale 1872
Moors, H., Esq., 498 Punt-road, South Yarra ... ... 1857
Muntz, T. B., Esq., C.E., 358 Collins-street, Melbourne 1870

Nanson, Professor E. T., M.A., University, Melbourne ... 1875
Neild, T. E., Esq., M.D., Bilton House, 21 Spring-street, Melbourne. 1865
Newbery, T. Cosmo, Esq., C.M.G., B.Sc., Technological Museum, Melbourne. 1866
Nimmo, W. H., Esq., Melbourne Club, Melbourne ... 1888

Officer, C. G. W., Esq., B.Sc., Glenbervie, Orrong-road, Toorak. 1890
Oldfield, Lenthal, Esq., 36 Nicholson-street, Fitzroy ... 1890

Rudall, J. T., Esq., F.R.C.S., corner Spring and Collins-street, Melbourne. 1868
Rule, O. R., Esq., Station-street, Canterbury, Victoria ... 1882

Sargood, Hon. Sir Frederick T., K.C.M.G., M.L.C., Elsternwick. 1883
Shaw, Thomas, Esq., Woorymite, Camperdown ... 1883
Spencer, Professor W. Baldwin, M.A., University, Melb. 1887
Stillwell, Alfred, Esq., 195a Collins-street East ... 1892
Sugden, Rev. E. H., B.A., B.Sc., Queen's College, Carlton 1889
Sutherland, Alexander, Esq., M.A., Heronswood, Dromana 1875
Sweet, George, Esq., Wilson-street, Brunswick ... 1887
Syme, G. A., Esq., M.B., F.R.C.S., 74 Collins-street ... 1890

Tisdall, H. T., Esq., F.L.S., Washington-street, Toorak ... 1883
Topp, C. A., Esq., M.A., LL.B., F.L.S., Grandview Grove, Armadale. 1887

Wilson, Rev. F. R. M., The Manse, Highbury Grove, Kew 1893
Wilkinson, W. Percy, Esq., Government Analyst's Office, Swanston-street. 1894

COUNTRY MEMBERS.

| | |
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| Cameron, John, Esq., Orbost .. ... ... | 1888 |
| Clark, Donald, Esq., School of Mines, Bairnsdale ... | 1892 |
| Conroy, Jas. McDowall, Wingham, Manning River, N.S.W. | 1877 |
| Dawson, T., Esq., Rennyhill, Camperdown ... ... | 1887 |
| Desmond, John, Esq., Warrnambool ... ... ... | 1891 |
| Dobson, A. Dudley, Esq., M.I.C.E., F.G.S., Warrnambool | 1891 |
| Fardy, M. J., Esq., California Gully, Bendigo ... ... | 1893 |
| Field, William Graham, Esq., C.E., Ottocrburn, Glenroy | 1880 |
| Foord, George, Esq., Boundary-road, Burwood... ... | 1871 |
| Ivey, James, Esq., Ballarat ... ... ... | 1888 |
| Keogh, Lawrence F., Esq., Haytesbury Park, Camperdown | 1872 |
| Loughrey, B., Esq., M.A., C.E., 3 Elgin-street, Hawthorn | 1880 |
| Macgillivray, P. H., Esq., M.A., M.R.C.S., Bendigo ... | 1857 |
| Manson, Donald, Esq., Elgin Buildings, Sydney, N.S.W. | 1884 |
| Murray, Stewart, Esq., C.E., Department of Mines, Melb. | 1874 |
| Oddie, James, Esq., Dana-street, Ballarat ... ... | 1882 |
| Oliver, C. E., Esq., C.E., Metropolitan Board of Works, Collins-street West. | 1879 |
| Powell, Walter T. D., Esq., Harbour Department, Brisbane, Queensland. | 1886 |
| Purdie, A., Esq., M.A., School of Mines, Bendigo . | 1892 |
| Shaw, W. H., Esq., Phœnix Foundry, Ballarat ... | 1888 |
| Williams, Rev. W., F.L.S., Wesleyan Parsonage, North Melbourne. | 1885 |
| Wilson, J. B., Esq., M.A., Church of England Grammar School, Geelong. | 1880 |

CORRESPONDING MEMBERS.

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|---|---|
| Bailey, F. M., Esq., The Museum, Brisbane ... ... | 1880 |
| Clarke, Hyde, Esq., 32 St. George's-square, London, L.W. | 1883 |
| Dendy, Arthur, Esq., D.Sc., F.L.S., Canterbury College, Christchurch, N.Z. | 1888 |

Etheridge, Robt., Esq., Junr., F.G.S., Department of Mines, Sydney, N.S.W. 1877

Stirton, James, Esq., M.D., F.L.S., 15 Newton-street, Glasgow. 1880

Ulrich, Professor G. H. F., F.G.S., Dunedin, Otago, N.Z. 1857

Wagner, William, Esq., LL.D., Philadelphia, U.S.A. ... 1884

## Associates.

Allan, M. J., Esq., 318 Smith-street, Collingwood ... 1887
Atkinson, John A., Esq., 2 Mary-street, Windsor ... 1894
Avery, D., Esq., Queen's College, University, Melbourne 1893

Bage, C., Esq., M.D., Achemar, 81 Toorak-road, South Yarra. 1885
Baker, Thomas, Esq., Bond-street, Abbotsford ... 1889
Bale, W. M., Esq., Walpole-street, Hyde Park, Kew ... 1887
Barnard, Robt. J. A., Esq., Queen's College, Carlton ... 1892
Best, Heinrich, Esq., c/o Mr. H. Falkner, Nightingale-street, Balaclava. 1890
Booth, John, Esq., C.E., Rennie-street, Coburg ... 1882
Bowen, W., Esq., 358 Collins-street, Melbourne ... 1887

Campbell, A. J., Esq., F.L.S., Elm Grove, Armadale ... 1894
Champion, H. V., Esq., Council Chambers, Williamstown 1882
Chase, L. H., Esq., Currajong, Riversdale-road, Hawthorn 1885
Craig, Robt., Esq., The Avenue, East Malvern ... 1890
Cresswell, Rev. A. W., St. John's Parsonage, Camberwell 1887

Danks, A. T., Esq., 42 Bourke-street West ... ... 1883
Dawson, W. S., Esq., Runnymede, Essendon ... ... 1887

Edwards, J. E., Esq., Colonial Telegraph Exchange, 133 Little Collins-street, Melbourne. 1879

Ferguson, W. H., Esq., 23 Service-street, Albert Park ... 1894
Fielder, Rev. W., Norwood, Mitchell-street, St. Kilda ... 1892
Finney, W. H., Esq., Bridport-street, South Melbourne 1881
Fison, Rev. Lorimer, M.A., Essendon ... ... 1889

Gabriel, J., Esq., Simpson's-road, Collingwood ... ... 1887

Haig, R. G., Esq., Bank Place, Collins-street, Melbourne 1888
Hart, J. S., Esq., M.A., Wilson-street, Brighton ... 1894
Hill, W. H. F., Esq., Glenrowan, Dandenong-road, Windsor. 1894
Holmes, W. A., Esq., Telegraph Engineer's Office, Railway Department, Melbourne. 1879
Hubbard, J. R., Esq., 125 Queen-street, Melbourne ... 1884

Ingamells, F. N., Esq., Observatory, Melbourne ... 1889

Kernot, Frederick A., Esq., Royal Park, Hotham ... 1881
Kirkland, J. B., Esq., F.C.S., University, Melbourne ... 1879
Kitson, A. E., Esq., 372 Albert-street, East Melbourne ... 1894

Lambert, Thomas, Esq., Bank of New South Wales, Collins-street. 1890
Le Soeuf, Dudley, Esq., Zoological Gardens, Royal Park 1894
Lidgey, E. A., Esq., Department of Mines, Melbourne 1894

Maclean, C. W., Esq., Walsh-street, South Yarra ... 1879
Melville, A. G., Esq., Mullen's Library, Collins-street East 1889
Moors, E. M., Esq., University, Sydney, N.S.W. ... 1885

Paul, A. W. L., Esq., Male-street, North Brighton ... 1883
Phillips, A. E., Esq., c/o Mr. Gordon, Little Flinders-street West. 1883
Pritchard, G. B., Esq., Mantell-street, Moonee Ponds ... 1892

Quarry, Herbert, Esq., Electrical Foreman, G.P.O., Melbourne. 1880

Riddell, Mrs., F.S.Sc., Lond., 21 May-road, Toorak ... 1889
Robertson, John Steele, Esq., B.A., University, Melbourne 1889
Robinson, C. A., Esq., Lands Department, Melbourne ... 1894
Ross, Joseph, Esq., M.D., 55 Fitzroy-street, St. Kilda ... 1889

Schaefer, R., Esq., Union-street, Windsor ... ... 1883
Shephard, John, Esq., 135 City-road, South Melbourne ... 1894
Slater, H. A., Esq., 121 Collins-street, Melbourne ... 1882
Smith, Mrs. Elderson, London Bank, 410 Brunswick-street, Fitzroy. 1890
Steele, W. H., Esq., Sherwood-street, Richmond ... 1892
Stewart, C., Esq., 9 Murphy-street, South Yarra ... 1883
Strettle, W. S., Esq., University, Melbourne ... ... 1891

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| Tate, Frank, Esq., B.A., Working Men's College, Latrobe-street. | 1889 |
| Tipping, Isaac, Esq., C.E., Meath House, Millsywn-street, South Yarra. | 1892 |
| Wilsmore, N. J. M., Esq., B.Sc., University, Melbourne | 1890 |
| Wilsmore, Mrs., University, Melbourne ... ... | 1893 |

# LIST OF THE INSTITUTIONS AND LEARNED SOCIETIES THAT RECEIVE COPIES OF THE "TRANSACTIONS" AND "PROCEEDINGS" OF THE ROYAL SOCIETY OF VICTORIA.

| | |
|---|---|
| Agent-General of Victoria ... ... ... | London |
| Anthropological Institute ... ... ... | London |
| Balfour Library ... ... ... ... | Cambridge |
| Biological Society of Liverpool ... ... ... | Liverpool |
| Bodleian Library ... ... ... ... | Oxford |
| British Museum ... ... ... ... | London |
| Colonial Office Library ... ... ... | London |
| "Electrician" ... ... ... ... | London |
| Foreign Office Library ... ... ... | London |
| Free Public Library ... ... ... ... | Liverpool |
| Geological Society ... ... ... ... | London |
| Institute of Mining and Mechanical Engineers ... | Newcastle |
| Institution of Civil Engineers ... ... ... | London |
| Linnæan Society ... ... ... ... | London |
| Literary and Philosophical Society ... ... | Liverpool |
| Literary and Philosophical Society ... ... | Manchester |
| Manchester Museum, Owens College ... ... | Manchester |
| Marine Biological Laboratory ... ... ... | Plymouth |
| Natural History Museum ... ... ... | London |
| Naturalists' Society ... ... ... ... | Bristol |
| "Nature" ... ... ... ... ... | London |
| "Natural Science" ... ... ... ... | London |
| Owens College Library ... ... ... | Manchester |
| Patent Office, 25 Southampton Building ... ... | London |
| Philosophical Society ... ... ... ... | Cambridge |
| Radcliffe Library ... ... ... ... | Oxford |
| Royal Asiatic Society ... ... ... ... | London |
| Royal Astronomical Society ... ... ... | London |
| Royal College of Science ... ... | South Kensington |
| Royal Colonial Institute ... ... ... | London |
| Royal Gardens ... ... ... ... | Kew |
| Royal Geographical Society ... ... ... | London |
| Royal Microscopical Society ... ... ... | London |
| Royal Society ... ... ... ... | London |
| Statistical Society ... ... ... ... | London |
| University College ... ... ... ... | London |
| University Library ... ... ... ... | Cambridge |
| Yorkshire College ... ... ... ... | Leeds |

### SCOTLAND.

| | |
|---|---|
| Botanical Society ... ... ... ... | Edinburgh |
| Geological Society ... ... ... ... | Edinburgh |
| Royal College of Physicians' Laboratory ... ... | Edinburgh |
| Royal Observatory ... ... ... ... | Edinburgh |
| Royal Physical Society ... ... ... | Edinburgh |
| Royal Society ... ... ... ... | Edinburgh |
| Royal Scottish Society of Arts ... ... ... | Edinburgh |
| Scottish Geographical Society ... ... ... | Edinburgh |
| University Library ... ... ... ... | Edinburgh |
| University Library ... ... ... ... | Glasgow |

### IRELAND.

| | |
|---|---|
| Natural History and Philosophical Society ... | Belfast |
| Royal Dublin Society ... ... ... ... | Dublin |
| Royal Geological Society ... ... ... | Dublin |
| Royal Irish Academy ... ... ... ... | Dublin |
| Trinity College Library ... ... ... | Dublin |

### GERMANY.

| | |
|---|---|
| Gessellschaft für Erdkunde ... ... ... | Berlin |
| Grossh. Hessische Geologische Anstalt ... ... | Darmstadt |
| Königl. Botanische Gessellschaft ... ... | Regensburg |
| Königl. Offentl. Bibliothek ... ... ... | Dresden |
| Königl. Preussische Akademie der Wissenschaften ... | Berlin |
| Königl. Sächs Gesellschaft der Wissenschaften ... | Leipzig |
| Königl. Societät der Wissenschaften ... ... | Göttingen |
| Naturforschende Gesellschaft ... ... ... | Emden |
| Naturforschende Gesellschaft ... ... ... | Halle |
| Naturforschende Gesellenschaft ... ... ... | Leipzig |
| Naturhistorisch Medizinischer Verein ... ... | Heidelberg |
| Naturhistorisches Museum ... ... ... | Hamburg |
| Naturhistorisches Museum ... ... ... | Hanover |
| Naturwissenschaftlicher Verein ... ... ... | Bremen |
| Naturwissenschaftlicher Verein ... ... ... | Frankfurt |
| Oberhessische Gesellschaft für Natur & Heilkunde ... | Giessen |
| Schlesische Gesellschaft dür Vaterländ. Cultur ... | Breslau |
| Verein für Erdkunde ... ... ... ... | Darmstadt |
| Verein für Erdkunde ... ... ... ... | Halle |
| Verein für Naturkunde ... ... ... | Kassel |

### AUSTRIA.

| | |
|---|---|
| Imperial Observatory ... ... ... ... | Prague |
| K. K. Akademie der Wissenschaften ... ... | Wien |

| | | |
|---|---|---|
| K. K. Geologische Reichsanstalt | ... ... | Wien |
| K. K. Geographische Gesellschaft | ... ... | Wien |
| K. K. Naturhistorisches Hofmuseum | ... ... | Wien |

SWITZERLAND.

| | | |
|---|---|---|
| Geographische Gesellschaft | ... ... ... | Berne |
| Geogr. Commerc. Gesellschaft | ... ... ... | St. Gallen |
| Geogr. Commerc. Gesellschaft | ... ... ... | Aarau |
| Naturforschende Gesellschaft | ... ... ... | Zurich |
| Schweizerische Naturforschende Gesellschaft | ... | Berne |
| Société de Physique et d'Histoire Naturelle | ... | Genéve |

FRANCE.

| | | |
|---|---|---|
| Académie des Sciences et Belles-Lettres et Arts | ... | Lyon |
| Annuaire Geologique Universel ... | ... ... | Paris |
| Faculté des Sciences ... | ... ... ... | Marseilles |
| Feuilles des Jeunes Naturalists ... | ... ... | Paris |
| Société Académique Indo-Chinoise | ... ... | Paris |
| Société de Geographie ... | ... ... ... | Paris |
| Société d'Etudes Scientifiques | ... ... ... | Paris |
| Société Nationale de Cherbourg | ... ... | Cherbourg |
| Société Zoologique deFrance... | ... ... | Paris |
| Soc. des. Sciences Naturelles de l'Ouest de la France (Museum) | ... ... ... ... | Nantes |

ITALY.

| | | |
|---|---|---|
| Biblioteca Nazionale Centrale Vittorio Emanuele | ... | Rome |
| British and American Archæological Society | ... | Rome |
| Museo di Zoologia ed Anatomia Comp., R. Universitá | | Turin |
| Ministero dei Lavori Pubblici | ... ... ... | Rome |
| R. Accademia della Scienze dell Institut ... | ... | Bologna |
| Reale Academia di Scienze | ... ... ... | Palermo |
| Reale Academia di Scienze, Lettre ed Arti | ... | Lucca |
| Regia Academia di Scienze, Eettere ed Arti | ... | Modina |
| Societá Geogrfica Italiana | ... ... ... | Rome |
| Societá Toscana di Scienze Naturali | ... ... | Pisa |
| Zoological Station | ... ... ... ... | Naples |

SPAIN AND PORTUGAL.

| | | |
|---|---|---|
| Real Academia de Ciencias Exactas, Fisicas y Naturales | | Madrid |
| Sociedade de Geographio | ... ... ... | Lisbon |

## HOLLAND AND BELGIUM.

| | |
|---|---|
| Académie Royale de Belgique ... ... ... | Bruxelles |
| Bataviaasch Genootschap van Kunsten en Wetenschappen, Soc. Roy. des Sciences naturelles de Céans ... ... ... ... ... | Batavia |
| Musée Teyler ... ... ... ... | Haarlem |
| Magnetical and Meteorological Observatory ... | Batavia |
| Natural Science Society ... ... ... | Amsterdam |
| Natuurkundig Genootschap ... ... ... | Groningen |
| Nederlandisch Botan. Vereiniging ... ... | Nijmegen |
| Royal Academy of Sciences ... .. ... | Amsterdam |
| Société Hollandaise des Sciences ... ... | Haarlem |
| Société Malacologique Royale de Belgique ... | Bruxelles |
| Société Provinciale des Arts et Sciences ... ... | Utrecht |

## DENMARK, SWEDEN, AND NORWAY.

| | |
|---|---|
| Académie Royale ... ... ... ... | Copenhagen |
| Entomologiska Foreningen ... ... ... | Stockholm |
| Societé des Sciences ... ... ... ... | Christiania |
| Swedish Academy of Sciences ... ... ... | Stockholm |
| University ... ... ... ... ... | Upsal |

## RUSSIA AND ROUMANIA.

| | |
|---|---|
| Institut Météorologique de Roumanie ... ... | Bucharest |
| Jardin Botanique Impérial ... ... | St. Petersburg |
| Soc. des Naturalistes de l'Université de Kazan ... | Kazan |
| Soc. des Naturalistes Kiew ... ... ... | Kiew |
| Société des Naturalistes de la Nouvelle Russie ... | Odessa |
| Société Impériale des Naturalistes ... ... | Moscow |
| Société Impériale Russee de Géographie ... | St. Petersburg |

## CAPE OF GOOD HOPE.

| | |
|---|---|
| South African Philosophical Society Observatory ... | Cape Town |

## INDIA AND MAURITIUS.

| | |
|---|---|
| Geological Survey of India ... ... ... | Calcutta |
| Madras Literary Society ... ... ... | Madras |
| Meteorological Society ... ... ... | Mauritius |
| Natural History Society ... ... ... | Bombay |
| Royal Bengal Asiatic Society ... ... ... | Calcutta |
| Royal Asiatic Society, Ceylon Branch ... ... | Colombo |

## China and Japan.

| | |
|---|---|
| Astronomical Observatory ... ... | Hong Kong |
| China Branch of the Royal Asiatic Society ... | Shanghai |
| Imperial University ... ... ... ... | Tokio |
| Seismological Society of Japan ... ... ... | Tokio |

## Canada.

| | |
|---|---|
| Canadian Institute ... ... ... ... | Toronto |
| Geological and Natural History Survey of Canada ... | Ottawa |
| Royal Society of Canada ... ... ... | Montreal |

## United States.

| | |
|---|---|
| Academy of Natural Sciences ... ... ... | Davenport |
| Academy of Natural Sciences ... ... | Philadelphia |
| Academy of Sciences ... ... ... | Son Francisco |
| American Academy of Arts and Sciences ... ... | Boston |
| American Geographical Society ... ... ... | New York |
| American Philosophical Society ... ... | Philadelphia |
| Astor Library ... ... ... ... | New York |
| Bureau of Ethnology ... ... ... | Washington |
| Colorado Scientific Society ... ... ... | Denver |
| Cooper Union for the Advancement of Science & Art | New York |
| Denison University ... ... ... ... | Ohio |
| John Hopkins University ... ... ... | Baltimore |
| "Kosmos" ... ... ... ... | San Francisco |
| Maryland Historical Society ... ... ... | Baltimore |
| Natural Academy of Sciences ... ... | Washington |
| Office of Chief of Engineers, U.S. Army ... | Washington |
| Philosophical Society ... ... ... | Washington |
| "Science" ... ... ... ... ... | New York |
| Smithsonian Institute ... ... ... | Washington |
| Society of Natural History ... ... ... | Boston |
| Society of Natural Sciences ... ... ... | Buffalo |
| Texas Academy of Sciences ... ... ... | Austin |
| United States Geological Survey ... | Washington |
| University of California ... | Berkley, San Francisco |
| Wisconsin Academy of Sciences, Arts, and Letters, | Madison, Wis. |

## Mexico.

| | |
|---|---|
| Ministerio de Fomento ... ... ... | Mexico |
| Observatorio Meteorologico, Magnetico Central ... | Mevico |
| Observatorio Astronomico National ... ... | Tatubaya |
| Sociedade Cientifica, Antonio Alsate ... ... | Mexico |
| Sociedad de Ingenieros de Jalisco ... | Guadalajara |
| Secretaria de Fomento ... ... ... | Guatemala |

## Argentine Republic.

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|---|---|
| Academia de Ciencias ... ... ... ... | Cordoba |
| Direccion General de Estadistica ... . | Buenos Ayres |
| La Museo di Plata . . ... ... | Buenos Ayres |

## Australia.—Victoria.

| | |
|---|---|
| "Age" ... ... ... ... ... | Melbourne |
| "Argus" ... ... ... ... ... | Melbourne |
| Athenæum ... ... ... ... ... | Melbourne |
| Astronomical Observatory ... ... ... | Melbourne |
| Chief Secretary's Office ... ... ... | Melbourne |
| Department of Mines and Water Supply ... ... | Melbourne |
| Field Naturalists' Club of Victoria ... ... | Melbourne |
| Free Library... ... ... ... ... | Echuca |
| Free Library ... ... ... . . | Geelong |
| Free Library ... ... ... ... | Bendigo |
| Geological Society of Australasia ... ... | Melbourne |
| Gordon Technical College ... ... ... | Geelong |
| Government Entomologist ... ... ... | Melbourne |
| Medical Society ... ... ... ... | Melbourne |
| Parliamentary Library ... ... ... | Melbourne |
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| Railway Library ... ... ... ... | Melbourne |
| Royal Mint ... ... ... ... ... | Melbourne |
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| School of Mines ... ... ... ... | Stawell |
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| "Victorian Engineer" ... ... ... | Melbourne |
| Victorian Institute of Surveyors ... ... | Melbourne |
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## New South Wales.

| | |
|---|---|
| Australian Museum ... ... ... ... | Sydney |
| Astronomical Observatory ... ... ... | Sydney |
| Department of Agriculture ... ... ... | Sydney |

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| Department of Mines ... ... ... ... | Sydney |
| Linnæan Society of New South Wales ... ... | Sydney |
| Parliamentary Library ... ... ... | Sydney |
| Public Library ... ... ... ... | Sydney |
| Royal Geographical Society ... ... ... | Sydney |
| Royal Society ... ... ... ... | Sydney |
| Technological Museum... ... ... ... | Sydney |
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| | |
|---|---|
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| | |
|---|---|
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| | |
|---|---|
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| | |
|---|---|
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# PROCEEDINGS.

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OF THE

# Royal Society of Victoria.

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*ISSUED APRIL, 1896.*

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THE AUTHORS OF THE SEVERAL PAPERS ARE SEVERALLY RESPONSIBLE FOR THE SOUNDNESS OF THE OPINIONS GIVEN AND FOR THE ACCURACY OF THE STATEMENTS MADE THEREIN.

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# CONTENTS OF VOLUME VIII.

## Art. I.—*Further Preliminary Notice of Certain New Species of Lizards from Central Australia.*

By A. H. S. Lucas, M.A., B.Sc., and C. Frost, F.L.S.

[Read 9th May, 1895.]

The following contains a description of three New Species of Lizards collected in Central Australia by Professor Baldwin Spencer. The full descriptions accompanied by figures, together with a complete report, will be published in the volume dealing with the work of the Horn Expedition.

### Ceramodactylus damæus, sp. nov.

*Description.*—Head large, high; snout obtusely pointed, a little longer than the distance between the orbit and the ear-opening. Ear-opening narrow, elliptical, oblique. Body slightly depressed. Limbs moderate, the fore-limb stretched forward reaches to between the eye and the nostril. Digits long, slender, inferiorly with small, imbricate, pointed scales. Head and upper surfaces of body, and limbs, covered with small granular scales. Rostral quadrangular, twice as broad as high, with median cleft above. Nostril pierced between the rostral, first labial, and four nasals, the supero-anterior nasals large, forming a suture with one another behind the rostral. Eleven or twelve upper and as many lower labials. Mental rather large, trapezoid; no chin shields. Gular scales very small, granular. Abdominal scales flat, subimbricate. Male with two or three blunt spines on each side of the base of the tail, and two widely separated præanal pores. Tail missing. *Colour.*—Pale whitish-grey above, darkest on the sides; a brownish, more or less broken band from the snout along each side of the back to tail; a broad, median whitish band from neck to base of tail; head spotted or reticulated with dark brown; sides with two longitudinal series of roundish white spots; limbs and under surfaces uniform whitish.

DIMENSIONS.

| | | | | |
|---|---|---|---|---|
| Head | ... | ... | ... | 11 mm. |
| Width of head | | ... | ... | 9 „ |
| Body | ... | ... | ... | 37 „ |
| Fore-limb | | ... | ... | 15 „ |
| Hind-limb | | ... | ... | 20 „ |
| Tail | ... | ... | ... | missing. |

*Locality.*—Charlotte Waters.

DIPLODACTYLUS BYRNEI, sp. nov.

*Description.*—Head short, convex; snout rounded, a little longer than the distance between the eye and the ear-opening; latter very small, rounded. Body short; limbs moderate, the fore-limb stretched forward reaches the anterior border of the orbit, the hind-limb to a little behind the axilla. Digits rather long, moderately depressed, inferiorly with transverse rows of discoid scales, usually two in a row; apical dilations small, the inferior plates sub-oval. Upper surfaces covered with minute granular scales, intermixed on the back with numerous regularly disposed rounded, or bluntly conical, tubercles. Rostral very low and broad, about four times as broad as high, without median cleft; nostril pierced in a swelling between the rostral, the first labial, and three nasals; internasal space concave. Eleven upper labials, the first very large and incompletely divided from the rostral; twelve lower labials, anterior very long, projecting behind the mental. Mental trapezoid, about as broad as long. Scales on the throat minute, granular; abdominal scales flat, roundish, juxtaposed, a little smaller than the dorsal tubercles. Tail cylindrical, tapering, with rings of scales convex above and flat, subquadrangular beneath. Male with three or four blunt spines on each side of the base of the tail. *Colour.*—Brownish-yellow above, with four broad, curved, dark brown bands on the body and five large spots on the tail; a dark brown spot behind the base of the hind-limb; most of the tubercles on the back dark brown; head from snout to behind the eyes uniform dull brown; under surfaces whitish.

DIMENSIONS.

| | |
|---|---|
| Total length ... ... | 77 mm. |
| Head ... ... ... | 12 ,, |
| Width of head ... ... | 9 ,, |
| Body ... ... ... | 32 ,, |
| Fore-limb ... ... ... | 15 ,, |
| Hind-limb ... ... | 20 ,, |
| Tail ... ... ... | 33 ,, |

*Locality.*—Charlotte Waters.

DIPOROPHORA WINNECKEI, sp. nov.

*Description.*—Habit slender; head rather narrow, with distinct canthus rostralis; covered above with sub-equal keeled scales; nostril equally distant from eye and the tip of the snout; tympanum moderate. A slight transverse gular fold. Dorsal scales large, uniform, feebly keeled, the keels directed obliquely towards the middle of the back; gular scales smooth; ventral scales feebly keeled, a little larger than those on the middle of the back; lateral scales smallest, latero-ventral largest. Limbs and digits rather long, the adpressed hind-limb reaches the tympanum in the male, and the shoulder in the female. No pores in our specimens.

*Colour.*—Reddish above, with darker and lighter spots; a broad bluish vertebral band, divided on the tail by a narrow line of ground colour; a narrow white band on each side from behind the eye to the base of the tail, and sometimes a broader one from axilla to groin. Under surfaces whitish with two broad dark-edged, bright yellow bands, united on the chest, and again in front of the hind-limbs, a band of the same colour along the front of the hind-limb from its base to the knee. Tail with a series of broad dark spots or annuli.

DIMENSIONS.—*Male.*

| | |
|---|---|
| Total length ... ... | 215 mm. |
| Head ... ... ... | 14 ,, |
| Width of head ... ... | 9 ,, |
| Body ... ... ... | 42 ,, |
| Fore-limb ... ... | 24 ,, |
| Hind-limb ... ... | 38 ,, |
| Tail ... ... ... | 159 ,, |

*Female.*

| | | |
|---|---|---|
| Total length | ... ... | 206 mm. |
| Head | ... ... ... | 16 „ |
| Width of head | ... ... | 9·5 „ |
| Body | ... ... ... | 45 „ |
| Fore-limb | ... ... | 24 „ |
| Hind-limb | ... ... | 39 „ |
| Tail | ... ... ... | 145 „ |

*Locality.*—Charlotte Waters.

# Art. II.—*Preliminary Description of Certain New Marsupials from Central Australia, together with Remarks upon the Occurrence and Identity of Phascologale cristicauda.*

By Professor Baldwin Spencer, M.A., C.M.Z.S.,

University of Melbourne.

[Read 13th June, 1895.]

The following includes a preliminary description of a new genus of the family Dasyuridæ and of a new species of the genus Sminthopsis from Central Australia, together with remarks upon the identity of *Phascologale cristicauda*, originally described by Krefft under the name of *Chætocercus cristicauda*.

My warmest thanks are due to my friend, Mr. P. M. Byrne, who, under difficulties of collecting and transit which cannot be fully appreciated unless one has personally endeavoured to collect in Central Australia during the hot season, secured the specimens which are now described. Thanks largely to the kindness of Mr. Byrne, I was able, during a visit paid to Central Australia in the recent summer, to secure several important forms of animal life which can only be met with after rain has fallen, and which are very characteristic of the Central fauna. The full description of these, together with those of the marsupials now dealt with, will be published in the volume dealing with the Horn Expedition.

## *Dasyuroides*, gen. nov.

Size small compared to Dasyurus; general build comparatively stout. Tail long.

Feet long and strong, not delicate as in Sminthopsis. Toes with strong, sharp, curved claws. Palms and soles very hairy, with the median part granulated. Soles with three well-marked pads placed on granulated elevations at the base of the toes.

Hallux entirely absent.

Pouch practically obsolete. Mammæ six.

Dentition $i. \frac{1.2.3.4}{1.2.3}. \; c. \frac{1}{1}. \; p.m. \frac{1.0.3.4}{1.0.3.0}. \; m. \frac{1.2.3.4}{1.2.3.4}.$

General dentition somewhat similar to that of those species of Phascologale in which the lower $p^4$ is wanting. Canines long and strong. Upper $p^4$ much smaller than $p^1$ and especially $p^3$. Lower $p^4$ entirely wanting.

Skull flattened in the frontal region as in Phascologale. The nasal bones very slightly expanded posteriorly. Bullæ very much swollen, the mastoid portion also inflated.

*Habits.*—Terrestrial; burrowing; insectivorous.

Range.—That of the only species.

*Dasyuroides byrnei*, sp. nov.

Size similar to that of the larger species of Phascologale. Form stout and strong. Fur close and soft, mainly composed of the under-fur. General colour a grizzled grey, with a faint rufous tinge, especially on the head and back.

Chin, ventral surface, inner sides of limbs and upper surface of hands and feet white.

Tail rufous coloured on rather less than its proximal half. The distal half thickly covered with long black hairs, which form a very well-marked dorsal and ventral crest.

Ears when laid forward reaching nearly to the anterior canthus of the eye.

Palms with five well-marked and faintly striated pads placed on granular elevations.

There is a small tuft of long white whisker-like hairs on the posterior surface of the fore-arm just above the wrist.

Soles with three well-marked pads placed on granular elevations at the base of the toes; the pads with fairly well-marked striations. The median part of the sole is naked and granulated. Each side has a strongly marked close set series of hairs bending over towards the middle line.

Tail fairly thick, but not incrassated.

Mammæ six. Pouch very slightly developed with two low lateral folds.

Skull flattened as in Phascologale but with the nasals very slightly broadened behind as in Sminthopsis.

Dentition $i. \frac{1.2.3.4}{1.2.3}. \; c. \; \frac{1}{1}. \; p.m. \; \frac{1.0.3.4}{1.0.3.0}. \; m. \; \frac{1.2.3.4}{1.2.3.4}.$

The dentition is somewhat similar to that of such a Phascologale as *Ph. apicalis*. Canines long and strong. That in the upper jaw measuring 3-4 mm. In the immature form the upper $p^4$ is wanting, in somewhat older specimen it is about the size of $p^1$, both of them being smaller than $p^3$. Lower $p^4$ quite wanting. Presumably there is no milk upper $p^4$.

DIMENSIONS OF ADULT MALE (in al.).

| | |
|---|---|
| Head and body ... ... | 182 mm. |
| Tail ... ... ... | 130 „ |
| Ear ... ... ... | 18 „ |
| Hind foot ... ... | 38 „ |

*Habitat.*—Central Australia. Charlotte Waters. Terrestrial; burrowing; insectivorous. Nocturnal. I have much pleasure in associating with this species the name of Mr. P. M. Byrne.

I have felt considerable hesitation in assigning this species to a new genus, but after a careful examination of the seven specimens (six males and one female) now in my possession, I have come to the conclusion that, as the genera of the family Dasyuridæ stand at present, no other course is possible. It is undoubtedly closely allied to the genera Phascologale and Sminthopsis, and shows at the same time an approach towards Dasyurus. The relationship to the two former are shown in the following points:—

(1) The general form of the body closely resembles that of the larger Phascologales or of a very small Dasyurus, and is very different from that of even the largest Sminthopsis.

(2) The shape of the hind foot is neither that of a Phascologale nor of a Sminthopsis. Judging by the length only (the one dimension given in descriptions) it might naturally be supposed that the foot was similar in proportions to such a form as *Ph. wallacei*. This, however, is far from being the case, as the foot of *Dasyuroides byrnei* is very much narrower than that of *Ph. wallacei*, and the two, when drawings of both of them are compared, are seen to belong to entirely different types of feet. The pads also on the soles are quite unlike those of typical

Phascologales, though this by itself is not perhaps a matter of the greatest importance. On the other hand, the foot is much more stoutly built than in the genus Sminthopsis.

In the absence of hallux it is markedly distinct from the foot of either genus.

(3). The pouch is very slightly developed as in Phascologale, and the mammæ, six in number, and not eight or ten as in Sminthopsis.

(4). The skull is flattened in the frontal region as in Phascologale, but on the other hand it differs from the latter and agrees with Sminthopsis in the character of the nasal bones, which are only very slightly expanded behind. The bullæ differ from those of Sminthopsis in having the posterior mastoid portion strongly inflated.

(5). The dentition on the contrary is similar to that of certain species of Phascologale. The lower $p^4$ is lost, and the upper $p^4$ is much smaller than $p^3$. The canines also are remarkably strong. In dentition it shows an approach as do also certain Phascologales to Dasyurus.

It will be seen that as at present defined this species cannot be placed in either of the genera Sminthopsis or Phascologale. In certain respects it presents characters at present regarded as distinctive of one or the other while it differs markedly from both in the entire absence of hallux.

To have associated it with these forms would have necessitated the merging of the two genera into one another, and the additional widening of the characters so as to include a non-hallucated form. The only other alternative was the creation of new genus, and I therefore adopted this plan, though at the same time it may be pointed out that with an increase in our knowledge of old and new species of these genera, a revision of them will certainly become necessary.

Dasyuroides may be therefore regarded as a genus closely allied both to Phascologale and Sminthopsis, and as showing also an approach to Dasyurus.

*Sminthopsis larapinta*, sp. nov.

Size small, form light and delicate. Fur very soft and fine, *moderately* long, composed almost entirely of under-fur with few

longer dark hairs. General colour a mouse grey suffused on the dorsal surface with rufous. The sides, under surface of the body and head, and upper surface of the hands and feet, white. Ears large, when laid forward they reach considerably beyond the eye.

Palms naked, granulated.

Tail much longer than the head and body. Very stout in its proximal part, and strongly incrassated. Very much stouter, longer and more incrassated than in *S. crassicaudata.* Tapering to a long thin end. Strongly scaled at the proximal end with short hairs not hiding the scales. Distally the hairs are more numerous and somewhat longer toward the tip.

Dentition $i. \frac{1.2.3.4}{1.2.3}. \; c. \frac{1}{1}. \; p.m. \frac{1.0.3.4}{1.0.3.4}. \; c. \frac{1.2.3.4}{1.2.3.4}.$

Teeth as usual in the genus. Canines small and the premolars increasing in size backwards.

DIMENSIONS OF ADULT MALE (in al.).

| | |
|---|---|
| Head and body ... ... | 88 mm. |
| Tail ... ... ... | 105 „ |
| Length of hind foot ... | 18.2 „ |
| Ear ... ... ... | 14 „ |
| Width of hind foot ... | 4 „ |

*Habitat.*—Central Australia, Charlotte Waters. Terrestrial.

The characteristic features of this form are (1) the remarkably long, very stout, and strongly-incrassated tail, and (2) the relative length of the foot as compared with *S. crassicaudata* or *murina.*

There is no difficulty in distinguishing it from the former, the specific name of which might with greater appropriateness have been applied to this species. I have some twenty adult specimens of *crassicaudata* from the same district, all agreeing closely with one another in relative dimensions, and markedly distinct from the species in question.

The specific name is adapted from the native name of the Finke River—the Larapinta—in which district it is found.

For the specimen upon which the species is founded I am indebted to Mr. P. M. Byrne.

## *Remarks upon the Occurrence and Identity of Phascologale cristicauda*, Krefft.

The exact determination of this species is a matter of very considerable difficulty. It was originally described by Mr. Krefft from a single specimen under the name of *Chætocercus cristicauda*, and was subsequently placed by Mr. Thomas in the genus Phascologale.

Through the kindness of Mr. Byrne I received some six adult and four immature specimens—all of them females—of what was apparently a species of Phascologale, though at the same time it showed in the structure of the feet more the character of a Sminthopsis, rendering it a matter of some difficulty to which genus, as at present described, it should be referred. On a subsequent visit to Charlotte Waters I obtained, also through the kindness of Mr. Byrne, additional specimens, two of them being males, and was able to see the animal alive. My collection now includes fifteen specimens. The mature ones all agree fairly closely in size with the measurements given by Mr. Krefft from his single specimen of *Ch. cristicauda.* The dentition shows the peculiarity of the latter, viz., absence of the lower $p^4$ and tubercular nature of the upper $p^4$.*

The black crest, typical of Krefft's species, was present, but differed from that described by him in being developed on the ventral as well as on the dorsal surface.

The peculiarity of the dentition, the crested tail and the general measurements of the body led me to refer the animal to Krefft's species. Unfortunately Krefft did not describe the feet, and the soles are distinguished by the presence of three granulated elevations bearing pads, and not by the presence of the five striated pads characteristic of the genus Phascologale. In relative dimensions the foot may be regarded as intermediate between the latter genus and Sminthopsis.

Mr. J. J. Fletcher very kindly, in response to my request, inspected and sent me a description of the type specimen, and subsequently, through the courtesy of Mr. R. Etheridge, Jun., the Curator of the Sydney Museum, to whose kindness I am much

* Krefft, P.Z.S., 1866, and "Mammals of Australia."

indebted, I had the opportunity of examining the specimen itself. The latter when received by Krefft was in a very bad condition, but there is enough of the orignal animal and fur remaining to show that both the description and figure* given by Krefft are exceedingly unsatisfactory. The animal is nothing like so rufous as in the drawing, being of a darker mouse colour with a lighter undersurface. The tail is much more swollen proximally than in the figure, shows traces of a rufous coloured proximal part, was evidently incrassated, and had both a dorsal and a ventral crest of hairs. Under the circumstances, viz., an originally badly preserved type specimen, a drawing which could not in certain respects (as to tail and colouration) have correctly represented the animal, and a description which is not only far from complete but is incorrect, there is considerable difficulty in assigning with certainty any newly found specimens to the species in question.

We have however the dimensions given by Mr. Krefft, the corrections in the description of the animal which can be made after inspection of the type and the peculiarity in the dentition noted by Mr. Krefft. A re-description, taking all these points into consideration, would apply so closely to the specimens recently obtained from Central Australia, that I have thought it better to amend the description given by Mr. Krefft, and to refer my specimens to the same species rather than to create a new one for their reception.

The amended description may be given shortly as follows. I shall deal fully with my specimens in the volume dealing with the Horn Expedition.

### *Phascologale cristicauda*, Krefft.

Size large. Form strong. Fur close and soft, and mainly composed of the under-fur.

General body colour, mouse grey, tinged with rufous dorsally. Under surface of head and body cream-white, as are also the upper and inner surfaces of the limbs.

Tail thickly covered on its upper and lateral surfaces with coarse chestnut-coloured hairs; ventrally the hairs are dark

---

* Krefft, P.Z S., 1866.

brown. About the middle of its length it is covered with coarse black hairs, which increase in length distally on the upper and under surface until, especially on the upper surface, they form a distinct black crest, a smaller crest being present ventrally.*

The tail is considerably swollen out proximally, and somewhat incrassated.†

Palms with six granulated elevations.

Soles with three granulated elevations, each with a small, unstriated pad, at the base of the toes.

Pouch opening vertically downwards, with moderately developed lateral folds. Mammæ six.

Dentition $i. \frac{1.2.3.4}{1.2.3}.$ $c. \frac{1}{1}.$ $p.m. \frac{1.0.3.4}{1.0.3.0}.$ $m. \frac{1.2.3.4}{1.2.3.4}.$

Canines long and strong; upper $p^4$ either absent or tubercular, lower $p^4$ always absent.

DIMENSIONS.

| — | Type Specimen. | Adult ♂ in al. | Adult ♀ in al. |
|---|---|---|---|
| Head and Body - - | 121 | 148 | 130 |
| Tail - - - | 83 | 89 | 85 |
| Ear - - - | — | 15·5 | 15.5 |
| Hind Foot - - - | 28 | 26 | 28 |

In the skull the frontal region is flattened, and the nasal bones are markedly broadened posteriorly. Bullæ much swollen: the posterior mastoid portion inflated.

*Habitat.*—South and Central Australia. The exact locality of Mr. Krefft's specimen is doubtful. He gives it as "probably Lake Alexandrina," that is, near the mouth of the Murray River. All of mine came from Central Australia. The animal

* This description, though considerably different from that given by Mr. Krefft, will still apply to the type specimen, as he appears to have quite overlooked the small crest on the under surface.

† This also applies to the type specimen.

is terrestrial in habit, burrowing in sandy and stony ground, and is nocturnal and insectivorous.

It will be noticed that the feet are, in regard to the pads, those of a Sminthopsis rather than a Phascologale. In reality, their dimensions are intermediate between those of the two genera; and as Phascologale is by no means so exclusively arboreal in habit as is usually supposed, I am inclined to lay less stress upon the presence of five striated pads on the sole of the foot than is usually done. I may here state that, as Mr. Thomas has pointed out, our knowledge of the forms comprised in the genera Phascologale and Sminthopsis is far from complete.

Mr. Zietz, of the Adelaide Museum, and myself have now a fair collection of the Australian representatives of those genera, and our work upon them has shown us that a revision of the genera, upon which we are now engaged, has become a matter of necessity.

## Art. III.—*Catalogue of Non-Calcareous Sponges collected by J. Bracebridge Wilson, Esq., M.A., in the neighbourhood of Port Phillip Heads.*

### Part II.

By Arthur Dendy, D.Sc.,

**Professor of Biology in the Canterbury College, University of New Zealand; Corresponding Member of the Royal Society of Victoria.**

### Introductory Remarks.

The present contribution deals with the important Monaxonid family of the Desmacidonidæ. These are very abundant in Victorian waters. No less than fifty-eight species are here catalogued, of which twenty-eight appear to be new. It has been necessary to institute three new genera, for which the names *Microtylotella*, *Amphiastrella* and *Fusifer* are proposed.

### Family DESMACIDONIDÆ.

Skeleton usually reticulate. Megascleres monactinal or diactinal. Microscleres always present, of various forms, but, with rare exceptions, including chelæ.

### Sub-family Esperellinæ.

Skeleton fibre not echinated by laterally projecting spicules.

### Genus *Esperella*, Vosmaer.

Megascleres always monactinal, smooth styli or tylostyli. Microscleres palmate anisochelæ, usually with other forms associated.

### *Esperella enigmatica*, Carter, sp.

*Esperia parasitica*, Carter, A.M.N.H., February, 1885, p. 108. *Pseudoesperia enigmatica*, Carter, A.M.N.H., December, 1886, p. 455.

This species is well characterised by its massive form, thick, loose dermal membrane, very coarse, sandy fibre, and the rosettes of peculiar quadridentate anisochelæ. As Mr. Carter himself abandoned the name *parasitica* as founded on a misconception, I have no hesitation in following his example. It appears scarcely necessary to retain the genus *Pseudoesperia.*

*R.N.* 335 (7 f; "dull orange-yellow"); 439 (s. 9, 13 f; "ochre-yellow"); 611 (s. 6, 8 f; "ochre-yellow"); 713 (s. 8); 853 (s. 9); 860 (s. 9).

*B.M.* d. 111 ("*Pseudoesperia enigmatica* olim *Esperia parasitica.*" Reg. 86-12-15-467).

### *Esperella phillipensis*, n. sp.

The single specimen forms a rather thin, spreading crust, with irregular surface and few small vents.

*Skeleton.* The main skelton is very lax and irregular, consisting of loose fibres and whisps of spicules running towards the surface and branching repeatedly as they approach the dermal membrane. Very numerous megascleres are also scattered in the ground substance between the fibres. The dermal skeleton is a rather close reticulation of loose spicular fibre.

*Megascleres*, long, straight, slender tylostyli, with well-marked ovoid heads and rather abrupt, sharp points, measuring about 0·3 by 0·005 mm.

*Microscleres*, (*a*) moderately stout, palmate anisochelæ, of ordinary form, occurring abundantly in rosettes and singly, and measuring about 0·037 mm. long when fully developed; (*b*) slender sigmata, simple and contort, with short, abruptly recurved, sharp points, measuring about 0·045 mm. from bend to bend by 0·0015 mm. in thickness in the middle.

*R.N.* 827 (s. 10).

### *Esperella spongiosa*, n. sp.

External form variable, from massive to flabellate or digitate. Soft and spongy, with thick, easily separable, reticulate dermal membrane. Vents commonly large and on prominent parts. Pale yellow in spirit. The colours in life recorded are dirty white, brown, vinaceous (purple), ochraceous buff, etc.; nothing very distinctive. Localities recorded: s. 1, s. 5, s. 9, x.

*Skeleton.* The main skeleton is a very irregular network of stout fibre, usually containing many spicules bound together by much spongin, often also containing much sand or broken spicules. Numerous megascleres are scattered in the ground substance. The dermal skeleton is a rather close reticulation of spicular fibre, echinated by abundant projecting spicules.

*Megascleres,* slender styli or tylostyli with feebly developed heads; gradually sharp-pointed at the apex; measuring about 0·158 by 0·0027 mm.

*Microscleres,* (*a*) slender palmate anisochelæ, scattered singly, about 0·025 mm. long and with narrow palm, of ordinary form; (*b*) some specimens contain a few slender, contort sigmata, about 0·066 mm. long from bend to bend. In many specimens there are scattered through the ground-substance, millions of minute, ovoid, highly refractive, very definite bodies, measuring about 0·0083 mm. in length. These occur in such numbers as to impart a peculiar opaque appearance to the whole sponge and also to sections. I do not at present understand their true nature.

This is a very unsatisfactory species, owing to the absence of constant and well-defined characters.

*R.N.* 280; 292; 350; 363; 372; 396; 408; 472; 525; 578; 579; 581; 588; 603; 648; 749; 805; 941; 968; 990; 1152; 1190; 1194.

### *Esperella arenicola,* Ridley and Dendy.

*Esperella arenicola,* Ridley and Dendy, Challenger Monaxonida, p. 72, pl. xv., figs. 4, 4a; pl. xvi., fig. 8.

This species, already obtained by the Challenger from Bass Straits, is represented in the collection by two specimens from the Queenscliff jetty, which agree very closely with the original type.

*R.N.* 689; 693.

### *Esperella toxifer,* n.sp.

Sponge massive, sessile, spreading, irregular. Surface uneven but subglabrous. Vents small, scattered on upper surface. Texture extremely soft and spongy, coarsely fibrous. Colour in spirit pale yellow; in life "wax ochre."

*Skeleton*, the main skeleton is very lax and irregular, consisting of branching, whisp-like, multispicular fibres, trending in a sinuous manner towards the surface, and branching freely, especially as they approach the surface; sometimes forming oblique anastomoses. A large quantity of very pale-coloured spongin invests these fibres. Very numerous megascleres are also scattered irregularly through the ground substance. There is no special dermal skeleton.

*Megascleres*, straight, slender tylostyli, gradually sharp-pointed and with fairly well developed ovoid heads; measuring about 0·2 by 0·004 mm.

*Microscleres*, (*a*) extremely minute and slender anisochelæ, only about 0·01 mm. long; (*b*) smooth, slender toxa, gradually sharp-pointed at the ends, measuring about 0·095 by 0·0017 mm.; (*c*) slender sigmata, simple and contort, measuring about 0·012 mm. from bend to bend, very rare.

*R.N.* 779 (Sorrento Jetty).

*Esperella crassa*, n. sp.

Sponge massive, irregular, lobose or ridged, with vents on prominent parts. Surface covered with delicate, minutely reticulate dermal membrane, with coarser reticulation of underlying parts showing through. Texture compact, incompressible, friable, intensely and coarsely sandy throughout. Dark brown in spirit.

*Skeleton*. The main skeleton is made up almost entirely of sand, not arranged in definite tracts or fibres, with the very much reduced proper spicules scattered in the soft tissues between. The dermal membrane is free from coarse sand but contains many foreign spicules arranged in a very loose and irregular network.

*Megascleres*, very slender styli or perhaps strongyla, commonly slightly curved, measuring about 0·16 by 0·002 mm. Most abundant just beneath the dermal membrane, pointing towards the surface.

*Microscleres*, minute, slender, palmate anisochelæ, of ordinary form, about 0·016 mm. long.

*R.N.* 521 (x, 20 f; "wood brown, the vents and inner surface sulphur yellow"); 939 (x A).

*Esperella rara*, n. sp.

The single specimen is massively lobose, very irregular. Surface irregularly conulose and rugose, with reticulate dermal membrane. Vents small, marginal and scattered. Texture very coarse, with much sand internally, compressible, resilient. Colour in spirit pale yellow.

*Skeleton*, composed largely of sand, arranged in coarse, loose, irregular fibres, with no evident cementing substance. The megascleres are very abundantly scattered in the soft tissues between, not arranged in definite fibres but in loose radiating whisps towards the surface. No special dermal skeleton.

*Megascleres*, straight slender tylostyli, sharply pointed and with small oval heads; measuring about 0·23 by 0·004 mm.

*Microscleres*, (*a*) slender, palmate anisochelæ, about 0·02 mm. long, often smaller; perhaps sometimes isochelæ; (*b*) short, slender trichodragmata, about 0·016 mm. long.

*R.N.* 1108 (x C).

Genus *Esperiopsis*, Carter.

Megascleres always monactinal, smooth styli or tylostyli. Microscleres isochelæ, to which other forms may be added.

*Esperiopsis turbo*, Carter, sp.

*Holopsamma turbo*, Carter, A.M.N.H., March, 1885, p. 213.

*Sigmatella turbo*, Lendenfeld, Monograph of Horny Sponges, p. 617.

This sponge is well characterised by its stipitate, pear-like shape, reticulate dermal membrane, skeleton of sandy fibres and greatly reduced spiculation. The megascleres are represented by slender styli, and the microscleres by very minute isochelæ, difficult to detect, both of which I have found in a fragment of Mr. Carter's specimen from the British Museum.

*R.N.* 265 (18 f; "dark purplish-brown"); 574 (x, 19 f; "brick red"); 647 (x, 20 f; "fawn colour over ferruginous"); 1050 (x B).

*B.M.* d. 50 ("*Holopsamma turbo*," Reg. 86-12-15-415).

Sub-genus *Pseudohalichondria*, Carter.

Differs from *Esperiopsis* only in the remarkable spined isochelæ.

*Pseudohalichondria clavilobata*, Carter.

*Pseudohalichondria clavilobata*, Carter, A.M.N.H., December, 1886, p. 454; pl. x., figs. 6-9.

This remarkable sponge, so well characterised by its spined isochelæ, appears to be not uncommon in Port Phillip.

*R.N.* 446 (s. 9, 17 f; "ochre-yellow"); 709 (s. 8); 857 (s. 9); 966 (s. 6); 986 (s. 9).

*B.M.* sp. 38 ("*Pseudohalichondria clavilobata*, C. *Type*;" Reg. 86-12-15-81); d. 14 (wrongly labelled "*Spongelia stellidermata*;" Reg. 86-12-15-287).

Genus *Desmacidon*, Bowerbank.

Megascleres always diactinal, smooth oxea or strongyla. Microscleres isochelæ, to which others may be added.

*Desmacidon australis*, n. sp.

Massive, irregular; with numerous vents scattered on prominent parts. Texture very sandy, sometimes with a dermal layer almost free from sand or with a beautiful minute sandy reticulation on the surface. Internally the sand is arranged in stout radiating columns whose ends may form pock-like markings on the surface. Grey in spirit.

*Skeleton.* The spicular skeleton is very much reduced, consisting mainly of slender strongyla scattered through the ground substance between the sandy columns and occasionally arranged in loose whisps, especially towards the surface. There may be a well-developed dermal reticulation of broken foreign spicules.

*Megascleres*, slender strongyla, measuring about 0·16 by 0·0028 mm.

*Microscleres*, (*a*) very slender tridentate isochelæ, about 0·012 mm. long, with small teeth; (*b*) very slender simple and contort sigmata, measuring about 0·02 mm. from bend to bend.

*R.N.* 303 (18 f; "dirty buff yellow"); 351 (19 f; "yellowish-brown, pale"); 532 (x, 19 f; "ochraceous"); 762 (s. 1); 929 (x A); 951 (s. 8); 999 (s. 1).

*Desmacidon stelliderma*, Carter sp.

*Halichondria stelliderma*, Carter, A.M.N.H., December, 1886, p. 451.

This species is characterised by its thick, lobose and compressed, or massively lobulate external form; with small vents scattered on prominent parts; soft and spongy texture and pale yellow colour in spirit. The main skeleton is a wide, sub-rectangularly meshed network of stout spicular fibre, containing very many slender spicules. At the surface radiating whisps of the same spicules surround the ends of the primary fibres in a stellate fashion. The megascleres are very slender, straight, smooth strongyla, commonly slightly inflated at the ends, and measuring about 0·18 by 0·0028 mm. The microscleres are thickly scattered through the ground substance and have the form of small tridentate isochelæ with strongly curved shafts and very minute flukes, the whole resembling a sigma and measuring about 0·01 mm. long.

*R.N.* 684 (s. 9); 710 (s. 8); 947 (s. 9); 955 (s. 6); 967 (s. 6).

*B.M.* sp. 29 ("*Halichondria stelliderma*, C. *Type*;" Reg. 86-12-15-148).

*Desmacidon intermedia*, n.sp.

Subcylindrical or slightly compressed, irregularly branched. Main stem up to one inch in diameter, tapering gradually to apex, nearly a foot long; branches much shorter and slenderer. Surface smooth and even, minutely reticulate, with thick dermal membrane, harsh to the touch. Vents very small, slightly prominent, uniserial or scattered on both margins. Firm, resilient, very tough. Very pale yellow in spirit, stained purplish on the surface.

*Skeleton*, a very irregular, coarse network of stout multispicular fibre, breaking up at the surface into close-set radiating tufts of oxea, whose shortly projecting points form the dermal reticulation. Many oxea are loosely scattered between the fibres, which themselves have no obvious cement.

*Megascleres*, rather stout, straight, sub-fusiform oxea, rather *abruptly* pointed at each end; measuring about 0·25 by 0·01 mm.

*Microscleres*, small tridentate isochelæ, with fairly stout strongly curved shaft and small but distinct triangular flukes. Length of the whole about 0·016 mm. These spicules are thickly scattered through the soft tissues.

This very interesting species is evidently closely related to the succeeding (*D. carnosa*).

*R.N.* 1163 (x).

### *Desmacidon carnosa*, Carter, sp.

*Fibulia carnosa*, Carter, A.M.N.H., January, 1886, p. 51.

This species closely resembles the preceding (*D. intermedia*), with its characteristic branched external form and strong spicular fibre composed of densely packed oxea, breaking up at the surface into a densely radiate dermal skeleton. The microscleres, however, are only minute C-shaped sigmata.

I have no doubt, from comparison with *D. intermedia*, that this is a *Desmacidon* with reduced or imperfectly developed chelæ. Even the sigmata appear sometimes to be absent (e.g. R.N. 354).

*R.N.* 354 (19 f; "bright orange-scarlet"); 402 (x, 19 f; "dull red"); 725 (s. 5; "orange-red"); 726 (s. 5; "orange-scarlet"); 852 (s. 9).

*B.M.* d. 112 ("*Fibulia carnosa*"; Reg. 86-12-15-372).

### *Desmacidon* (?) *arenifibrosa*, n. sp.

Erect, short-stalked, palmo-digitate, very irregular; branches short, blunt, compressed or subcylindrical. Surface subglabrous, very minutely reticulate; in parts with much projecting fibre, in parts minutely conulose. Vents small, scattered. Compressible, resilient, tough. Greyish-yellow in spirit.

*Skeleton.* The main skeleton is a very definite and fairly uniformly distributed but not very regular reticulation of stoutish pale coloured horny fibre, almost filled throughout with sand and broken spicules. The primary fibres, radiating to the surface, are about 0·1 mm. thick and the connecting fibres are rather slenderer. The meshes of the network are wide but extremely variable. There is a very well-developed, close-meshed dermal reticulation, composed of sand and broken spicules and with small rounded meshes.

*Megascleres.* Many foreign megascleres are present but I have not found any which can be safely regarded as belonging to the sponge.

*Microscleres.* Immense numbers of very minute isochelæ are scattered through the soft tissues. These are very slender and have sharply recurved, very slender median palms running almost parallel with the main shaft for about a third of its length, the lateral palms being inconspicuous. Length about 0·016 mm.

*R.N.* 979 (s. 5).

### *Desmacidon* (?) *chaliniformis*, Carter, sp.

*Dysidea chaliniformis*, Carter, A.M.N.H., March, 1885, p. 217.

In the fragment of Mr. Carter's specimen sent to me from the British Museum I find numerous minute isochelæ of peculiar shape, sparsely and irregularly scattered through the dried-up soft tissues between the sandy fibres. These spicules measure about 0·012 mm. in length. They have a very slender, very slightly curved shaft, with apparently three very short, blunt teeth widely divergent from each end, but all apparently on the same side. It is very difficult to make out the exact form of the spicule, which makes a near approach to the minute amphiastra or birotulates of *Iotrochota.* The presence of these spicules seems to necessitate the placing of this species in the *Esperellinæ.* I have found no proper megascleres.

Whether all the specimens included by von Lendenfeld under the name *Phoriospongia chaliniformis** belong to the same species appears very doubtful.

*B.M.* d. 8 ("*Dysidea chaliniformis.*" Reg. 86-12-15-341).

### Genus *Iotrochota*, Ridley.

Megascleres styli, sometimes with diactinal forms also. Microscleres amphiasters (birotulates†). Colour usually dark purple.

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* Monograph of Horny Sponges, p. 600.

† Usually extremely minute.

*Iotrochota coccinea*, Carter sp.

*Halichondria birotulata*, Carter, A.M.N.H., January, 1886, p. 52.

*Axinella coccinea*, Carter, A.M.N.H., November, 1886, p. 378.

Erect, lamellar to digitate, or thickly lobose. Surface smooth, glabrous but uneven, sometimes minutely conulose. Vents rather small, scattered. Soft and spongy, resilient, rather tender. Very dark purple throughout, colouring the spirit.

*Skeleton.* The main skeleton is a coarse, subrectangular but irregular wide-meshed network of fibres containing many spicules and a great deal of spongin. The diameter of the meshes varies greatly. The primary fibres are about 0·09 mm. thick, the secondaries somewhat thinner, both multispicular. There is usually no skeleton at all in the dermal membrane, only occasionally a few scattered spicules. Spicules also occur scattered between the fibres of the main skeleton.

*Megascleres*, slender styli, straight or slightly curved, usually well-pointed, measuring about 0·2 by 0·004 mm. Slight variations in size and proportions occur, and I have also seen a few rounded at both ends (strongyla).

*Microscleres.* Excessively minute amphiastra (birotulates), very hard to find, very slender and only about 0·0072 mm. long. I have not been able to resolve the terminal knobs into teeth.

Mr. Carter identified this species with Higgin's *Halichondria birotulata*, which is also an *Iotrochota*. It seems to me better to keep them distinct, although the species of this genus are extremely hard to satisfactorily distinguish, and they may all be mere local varieties of Bowerbank's *I. (Halichondria) purpurea.* As Mr. Carter has described the same species (as shown by examination of his type from the British Museum) under the name *Axinella coccinea*, the name *coccinea* may be conveniently retained.

*R.N.* 332 (18 f; "black, with maroon purple tint in the juice"); 1064 (x A); 1164 (x); 1175.

*B.M.* sp. 37 ("[Iotrochota] [Halichondria] birotula Higgins;" Reg. 86-12-15-109); sp. 64 ("*Axinella coccinea* C. Type;" Reg. 86-12-15-8).

*Iotrochota acerata*, n.sp.

Compressed, lobose, sessile, irregular and somewhat cavernous. Vents small and scattered, some marginal. Surface glabrous but uneven; minutely reticulate in parts. Texture soft and spongy, but at the same time tough and fibrous. Colour in life and in spirit dark brown.

*Skeleton*, a very loose and irregular, rather small-meshed reticulation of multispicular fibre, usually with indistinct spongin. Many megascleres are loosely scattered between the fibres. There is no special dermal skeleton beyond a few sparse, radiating tufts of strongyla. The reticulate character of the dermal membrane is due to the arrangement of the underlying soft tissues.

*Megascleres*, (*a*) smooth styli, usually more or less curved; evenly rounded off at one end and sharply pointed at the other; size variable, say about 0·2 by 0·006 mm.; (*b*) smooth oxea, of about the same size and shape as the styli but sharply pointed at both ends; (*c*) smooth strongyla, straight or nearly so, and evenly rounded off at both ends, varying from a little shorter and stouter to a little longer and slenderer than the average styli. All these forms are abundantly intermingled in the deeper parts of the sponge, but the sparse dermal tufts appear to consist chiefly if not entirely of the strongylote megascleres.

*Microscleres*, the usual amphiastra, usually about 0 012 mm. long.

This species is distinguished by its brown colour, and by the presence of the abundant oxeote megascleres. From *I. coccinea* it is also distinguished by the much larger microscleres.

*R.N.* 434 (x, 19 f; "seal brown with a coating of olive yellow").

Genus *Forcepia*, Carter.

Megascleres usually diactinal, tylota or strongyla, sometimes becoming stylote. Microscleres isochelæ and forcipes, possibly with other forms.

*Forcepia colonensis*, Carter.

*Forcepia colonensis*, Carter, A.M.N.H., February, 1885, p. 110.
*Suberites biceps*, Carter, A.M.N.H., February, 1886, p. 117.

This remarkable sponge appears to be rare. Two of the specimens which I now refer to it (R.N. 599 and 1131) have very much smaller forceps spicules than the type and may possibly be distinct. The type of *Suberites biceps* in the British Museum contains spined forceps, isochelæ and (?) sigmata and is obviously referable to *Forcepia colonensis.*

*R.N.* 549 (x, 19 f; "geranium red"); 599 (x, 19 f; "poppy red"); 1131 (x).

*B.M.* d. 106 ("*Forcipia colonensis*," Reg. 86-12-15-363); sp. 12 ("*Suberites biceps, C. type*," Reg. 86-12-15-52).

### *Forcepia carteri*, n. sp.

Sponge massive, irregular. Surface very uneven, with scabid, subdivided sandy areas. Texture cavernous, compact between, with large sandy tracts; firm. Greyish-yellow in spirit.

*Skeleton*, composed chiefly of sand, not arranged in fibres but in dense irregular accumulations with comparatively clear areas of soft tissue between. There are also numerous megascleres, mostly arranged in very loose and irregular whisps.

*Megascleres*, straight, slender strongyla, nearly cylindrical, sometimes swollen into a slight head at one end; measuring about 0·24 by 0·004 mm.

*Microscleres*, (*a*) slender tridentate isochelæ, about 0·012 mm. long, with strongly curved shaft and short teeth; (*b*) forcipiform, very slender, about 0·08 mm. long, like a pair of hair-like rhaphides united at one end and curving somewhat apart at the other. The two limbs often appear separately, and are then indistinguishable from ordinary rhaphides. These spicules are very numerous.

The species makes a near approach to Carter's *Forcepia crassanchorata** from Port Elliot, S.A., but differs in details of spiculation.

*R.N.* 607 (x, 20 f; "ochre yellow").

### Genus *Microtylotella*, nov. gen.

Megascleres diactinal (tylota). Microscleres isochelæ and microtylota, to which others may be added.

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* A.M.N.H., February, 1885, p. 111, pl. iv., fig. 3, a-g.

(The term "microtylota" is here proposed for an apparently new type of microsclere consisting of a long slender shaft with a knob at each end).

### *Microtylotella güntheri*, n. sp.

Massive, solid and heavy. Vents (in one specimen) few, large, on broad rounded margin. Very hard; composed chiefly of coarse sand arranged in dense, stout, close-packed, radiating columns, whose ends may form a meandriniform pattern on the upper surface. Colour in spirit sandy brown.

The spicular skeleton is reduced to insignificance in comparison with the coarse sand, but slender spicules are abundantly scattered through the soft tissues.

*Megascleres*, long, slender, nearly straight tylota, with slightly developed heads; size about 0·28 by 0·003 mm.

*Microscleres*, (*a*) very minute, slender isochelæ, about 0·012 mm. long, of ordinary form like those figured by Carter for *Forcepia colonensis*; (*b*) smooth, slender toxa, of extremely variable dimensions, sometimes so long and so slightly curved as to resemble raphides; (*c*) microtylota, with very slender, straight or nearly straight shaft, which may be very faintly microspined, terminating at each end in a small button-like knob (perhaps slightly toothed); the whole about 0·08 mm. long and 0·0015 mm. thick in the shaft.

I have much pleasure in dedicating this remarkable species to Dr. Günther, of the British Museum, as a slight recognition of his many kindnesses.

*R.N.* 473 (x, 20 f; "bay"); 757 (s. 5, "vermilion").

### Genus *Histoderma*, Carter.

Sponge consisting of a massive body throwing off hollow processes or fistulæ; with a more or less strongly-developed cortex of horizontally-placed megascleres. Megascleres usually diactinal, but ranging from tylota to styli. Microscleres isochelæ, to which others may be added.

*Siderodermma*, Ridley and Dendy, may possibly have to fall under this genus.

*Histoderma verrucosum*, Carter.

*Histioderma verrucosum*, Carter, A.M.N.H., December, 1886, p. 452.

*Histioderma polymasteides*, Carter, A.M.N.H., December, 1886, p. 453.

The isochelæ may be extremely rare. In *R.N.* 392 and 398 I have not been able to find any, and in *B.M.* sp. 36 I could only find one.

*H. polymasteides* would appear from the description to be merely a more robust variety, but I have seen no specimen.

*R.N.* 392; 398; 627 (x, 19 f; "buff"); 808 (s. 5); 1189.

*B.M.* sp. 36 ("*Histioderma verrucosum*," Reg. 86-12-15-74).

Genus *Amphiastrella*, nov. gen.

Sponge consisting of a massive body throwing off hollow fistulæ from the upper surface and (sometimes) with root-like processes below. Body with a dense cortex of horizontally-placed spicules. Megascleres diactinal, strongyla or tylota. Microscleres amphiasters (birotulates), to which others may be added.

The erection of a new genus for Carter's *Phlœodictyon birotuliferum* seems to me necessary. The name *Phlœodictyon* was first used by Mr. Carter for entirely different forms.

*Amphiastrella birotulifera*, Carter, sp.

*Phlœodictyon birotuliferum*, Carter, A.M.N.H., December, 1886, p. 447, pl. x., figs. 1-5.

As this very remarkable species is hitherto known only from a fragment (one of the branching tubes), I propose to supplement Mr. Carter's detailed account with the description of a second specimen dredged by Mr. Wilson.

Sponge massive, depressed, sessile, irregular, thickly encrusted with shell debris and other rubbish. Lower surface sending out numerous rather slender, elongated, rootlike processes, attached to which are pebbles, &c. Upper surfaces giving off a few irregular, slender, elongated fistulæ, most of which are closed at the apex (? two open naturally). These hollow fistulæ branch irregularly, and some have distinctly reticulate walls. The body of the sponge is dense and compact, and is enclosed on all sides

by a rather thin but very dense and hard cortex. Colour in spirit, where visible, pale yellow or brown.

*Skeleton*, in the interior of the body are scattered many megascleres, not arranged in definite fibres. In the cortex they are very densely packed, lying in various directions, more or less parallel to the surface, and forming a thick solid crust. In the walls of the fistulæ they are arranged in loose, stout bands or fibres, which form an irregular network, with many spicules scattered in the meshes between.

*Megascleres*, straight or slightly-curved strongyla or tylota, with slightly-developed oval heads ; size about 0·4 by 0·008 mm., but variable, sometimes much longer and slenderer.

*Microscleres*, (*a*) amphiasters (birotulates), varying in size up to about 0·05 mm. long, with shaft 0·0042 mm. thick. The shaft is commonly slightly constricted in the middle, and may be thickened at each side of the constriction. The umbrella-like ends may have as many as nine teeth or ribs ; (*b*) slender sigmata, say 0·04 mm. from bend to bend, but variable. Neither kind of microsclere is abundant, and they might easily be overlooked.

*R.N.* 942 (x A).

*B.M.* sp. 35 ("*Phlœodictyon birotuliferum*," Reg. 87-7-11-12).

## Genus *Damiria*, Keller.

Skeleton reticulate. Megascleres of two forms, both diactinal; those of the main skeleton oxea, those of the dermal skeleton tylota (? sometimes strongylote or tornote).

Microscleres isochelæ, usually accompanied by sigmata.

Not having access here to Keller's original description, I owe my information as to this genus to Topsent's useful paper, "Une Réforme dans la Classification des Halichondrina."*

### *Damiria australiensis*, n. sp.

Form very variable, ranging from massive to digitate; with conulose or meandriniform surface and delicate dermal membrane between the projecting portions. Vents variable, large or small, scattered or on mammiform or digitiform projections. Texture soft and spongy. Colour in spirit pale yellow.

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* Mémoires de la Société Zoologique de France. Tome VII., p. 5, 1894

*Skeleton.* The main skeleton is a dense, irregularly isodictyal network of oxea. Towards the surface this is replaced by radiating, branching whisps of tylota.

*Megascleres,* (*a*) rather slender, slightly curved, smooth oxea, gradually sharp-pointed at each end, measuring about 0·2 by 0·008 mm. (very rarely a stylote spicule occurs amongst them); (*b*) tylota, with well-developed oval heads, smooth, straight; about 0·25 by 0·005 mm.

*Microscleres,* (*a*) tridentate isochelæ like those of *Myxilla*; fairly stout and about 0·028 mm. long, but varying in size; (*b*) Sigmata, small, slender, simple and contort, about 0·02 mm. from bend to bend.

*R.N.* 361 (s. 15, 3 f; "bright orange red"); 451 (s. 9, 17 f; "rufous"); 662; 673 (s. 10); 717 (s. 10); 718 (Sorrento Reef); 719 (Sorrento Reef); 722 (Sorrento Reef); 836 (s. 10); 837 (s. 10); 838 (s. 10); 845 (s. 10); 861 (s. 9); 903 (s. 10); 919 (s. 10); 997 (s. 14).

### Sub-family Ectyoninæ.

Skeleton fibre echinated by laterally projecting styli, usually spined.

### Genus *Myxilla*, Schmidt.

Main skeleton reticulate, composed of usually spined styli, and sometimes echinated by spined styli or tylostyli of different form. Variously ended diactinal megascleres are also present, chiefly at the surface. There is usually very little spongin. Microscleres tridendate isochelæ, to which sigmata may be added.

Seeing that the type of this genus, *M. rosacea*, has no special echinating spicules, I cannot agree with Topsent in separating such forms as a distinct genus under Gray's name *Dendoryx*. *Myxilla* has several years' precedence over *Dendoryx*, and at present I propose to retain the name *Myxilla* both for species with and species without special echinating spicules (*vide* Challenger Report). Similarly, Topsent's *Lissodendoryx* falls under *Myxilla*, for the degree of spination of the styli varies so much that it is impossible to draw a hard and fast line between the two.

*Myxilla isodictyalis*, Carter, sp.

*Halichondria isodictyalis*, Carter, A.M.N.H., April, 1882, p. 285, pl. xi., fig. 2.

*Halichondria isodictyalis*, Carter, A.M.N.H., January, 1886, p. 52.

*Halichondria incrustans*, Coll. Brit. Mus.

The sponge is massive, sessile, usually with more or less conulose surface and rather large scattered vents. The skeleton is an isodictyal network of smooth styli, with tylota radiating in whisps towards the surface and scattered in the dermal membrane. The microscleres are small isochelæ and sigmata.

*R.N.* 690 (s. 7); 773 (Sorrento Jetty, "wax yellow"); 778 (Sorrento Jetty, "wax yellow"); 793 (Sorrento Jetty, "dull wax yellow"); 872 (s. 5); 886 (s. 9); 897 (s. 10); 953 (s. 6); 965 (s. 6).

*B.M.* d. 103 (labelled "*Halichondria incrustans*," which is explained by Mr. Carter's remarks *loc. cit.*, Reg. 86-12-15-391).

*Myxilla victoriana*, n. sp.

*Halichondria pustulosa*, Carter, A.M.N.H., December, 1886, p. 450.

*Halichondria pustulata*, Coll. Brit. Mus.

Not *Halichondria pustulosa*, Carter, A.M.N.H., April, 1882, p. 285, pl. xi., fig. 1.

Massive, irregular, with uneven, rugose or warty surface and scab-like pore-areas. Vents small and scattered. Texture fairly compact, but soft and spongy. Pale yellow in spirit.

*Skeleton*, the main skeleton is an irregular reticulation of spicular fibres, with rather strongly-developed multispicular primary lines running towards the surface. The fibres contain a considerable quantity of pale-coloured spongin, and are abundantly echinated by the spined styli. The dermal skeleton consists of the slender diactinal spicules (sometimes stylote) radiating in whisps at the surface, and especially developed in a beautifully radiate manner around the scab-like pore-areas.

*Megascleres*, (*a*) Main styli, smooth, slightly curved and gradually sharp-pointed, sometimes with a faint indication of spination at the base; size about 0·2 by 0·0082 mm.; (*b*) Echin-

ating styli, straight, gradually sharp-pointed and spined all over, size about 0·1 by 0·0082 mm.;* (*c*) Dermal spicules, straight, smooth, long and slender, varying in form from tylote to tylostylote, with feebly-developed oval heads; size about 0·25 by 0·003 mm.

*Microscleres*, rather stout tridentate isochelæ, of the usual *Myxilla* pattern, about 0·025 mm. long. Very abundant.

This species is evidently distinct from Carter's original *Halichondria pustulosa*, as is clearly seen by reference to his description and figures.

*R.N.* 492 ("brick red"); 835; 844; 895; 922. All from station 10.

*B.M.* d. 97 ("*Halichondria pustulata*," Reg. 87-7-11-26).

Genus *Microciona*, Bowerbank (emended).

Skeleton consisting of plumose columns. Megascleres all monactinal, smooth and spined. Typical microscleres isochelæ.

*Microciona scabida*, Carter, sp.

*Halichondria scabida*, Carter, A.M.N.H., February, 1885, p. 112, pl. iv., figs. 4, 5.

*Halichondria scabida*, Carter, A.M.N.H., December, 1886, p. 449.

This species appears to come much nearer to Carter's original "*Halichondria pustulosa*" than does *Myxilla victoriana*, which he referred to that species.

*R.N.* 413 (x, 19 f; "orpiment-orange"); 1025 (x B); 1038 (x B).

Genus *Clathria*, Schmidt.

Skeleton a reticulation of fibre, usually with much spongin, cored by smooth styli and echinated by spined styli. Typical microscleres small palmate isochelæ.

I propose to drop the genus *Rhaphidophlus* of Ehlers, which differs from *Clathria* only in the strongly-developed dermal crust of radiately-disposed styli. It is impossible to draw a sharp distinction between the two.

* The diameter given for spined styli is always exclusive of the spines.

*Clathria typica*, Carter, sp.

*Echinonema typicum*, Carter, A.M.N.H., May, 1881, p. 378.

*Echinonema anchoratum*, Carter, A.M.N.H., May, 1881, p. 379.

*Echinonema flabelliformis*, Carter, A.M.N.H., November, 1885, p. 352.

*Echinonema pectiniformis*, Carter, A.M.N.H., November, 1885, p. 353.

*Phakellia ventilabrum*, var. *australiensis*, Carter, A.M.N.H., November, 1886, p. 379.

This very common and variable species ranges from digitate to flabellate in shape. It is characterised by the stout, echinated, horny fibre and dermal crust of small styli. The megascleres are smooth styli, long and slender in and between the fibres, shorter at the surface, and short spined echinating styli. The microscleres are minute isochelæ, and very slender, hair-like toxa, often in bundles (toxodragmata). The latter, although not mentioned by Carter, are present in B.M. d. 96 and B.M. sp. 48. R.N. 383, 436 and 551 are distinguished from the majority of the specimens by the absence (apparently) of toxa and the more strongly-developed megascleres, but such differences are hardly of specific importance in the genus *Clathria*.

*R.N.* 359 (s. 15, 3 f; "dull dirty brick red"); 431 (x, 19 f; "salmon colour"); 438 (s. 14, 11 f; "vinaceous-rufous"); 677 (s. 5; "scarlet"); 797 (s. 9); 840 (s. 10); 900 (s. 10); 959 (s. 6); 1072 (x A).

*Variety* 383; 436 (x, 19 f; "brick red"); 551 (x, 19 f; subdued crimson).

*B.M.* sp. 48 ("*Echinonema pectiniformis*, C. type," Reg. 86-12-15-141); d. 85 ("*Phakellia ventilabrum*, var. *australiensis*," Reg. 86-12-15-422); d. 96 ("*Echinonema anchoratum*," Reg. 86-12-15-423).

*Clathria angulifera*, n.sp.

Sponge thinly lamellar, very proliferous, anastomosing, low-growing, spreading; vents small, scattered and marginal. Surface glabrous. Texture compressible, resilient, fairly tough. Colour in spirit, very pale yellow.

*Skeleton*, an irregular but well-defined and rather close-meshed network of rather slender fibre. The fibre is composed of very

pale spongin, cored by fairly abundant smooth styli and sparsely echinated by spined styli. The spicules occur irregularly in the fibres, not forming a compact axial core. Few spicules are scattered between the fibres. The dermal skeleton is composed of very loose radiating whisps of long slender styli.

*Megascleres*, (*a*) smooth, straight styli, in the fibres of the main skeleton, gradually sharp-pointed; size variable, say about 0·18 by 0·0042 mm.; (*b*) long, straight, slender styli or subtylostyli of the dermal tufts, say about 0·25 by 0·0035 mm.; (*c*) echinating styli; short, straight, gradually sharp-pointed, feebly spined; about 0·058 by 0·004 mm.

*Microscleres*, (*a*) extremely minute isochelæ, very slender and hardly 0·006 mm. long; (*b*) rather short, stout toxa, very strongly angulate* in the middle, sometimes forming almost a right angle with nearly straight limbs; smooth and sharp-pointed; size variable, up to about 0·07 mm. from point to point in a straight line, by 0·004 mm. in diameter. I have also observed a few hair-like rhaphides, possibly young forms of megascleres, and one stoutish contort sigma.

*R.N.* 1160 (x).

### *Clathria australiensis*, Carter, sp.

*Wilsonella australiensis*, Carter, A.M.N.H., November, 1885, p. 366.

This appears to be simply a *Clathria* with a large amount of foreign matter (sand and broken spicules) in and between the fibres and on the surface. The sand is especially abundant in the primary fibres. A considerable amount of spongin is also present. In the three specimens which I now refer to the species I find a few slender toxa, which are not mentioned in the original description.

*R.N.* 748 (s. 1; "cherry red"); 969 (s. 5); 1002 (s. 1).

*B.M.* sp. 76 (*Wilsonella australiensis*, C. type," Reg. 86-12-15-43); d. 13 (wrongly labelled "*Spongelia*," Reg. 86-12-15-288).

### *Clathria echinonematissima*, Carter, sp.

*Wilsonella echinonematissima*, Carter, A.M.N.H., March, 1887, p. 210.

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* Whence the specific name.

There seems to be little doubt, from Mr. Carter's description, that this species is a Clathria, but I have not yet had the opportunity of examining it.

*Clathria piniformis*, Carter, sp.

*Dictyocylindrus piniformis*, Carter, A.M.N.H., November, 1885, p. 354.

This is apparently an aberrant *Clathria*. The sponge is erect, lobo-digitate or flabellate, with corrugated surface. There is a well-developed horny fibre, and the spicules are all very slender. The megascleres are long slender styli which may become oxeote, and short slender echinating styli, which may also become oxeote. The latter are spined as usual, and the oxeote tendency seems to be very characteristic. No microscleres are visible.

*R.N.* 412 (x, 19 f; "cadmium orange"); 508 (x, 20 f; "brick red").

*B.M.* sp. 75 ("*Dictyocylindrus piniformis*, C. type," Reg. 86-12-15-62).

*Clathria alata*, n. sp.

Sponge massive, irregular, with rugose or warty surface and thick, tough, smooth dermal membrane. Vents large and small, scattered. Texture fairly firm but compressible and resilient. Pale yellow or brown in spirit.

*Skeleton*, the spicular skeleton is very strongly-developed, partly in stout, whisp-like, multispicular fibres, enveloped in much spongin and forming a very loose, irregular network; the fibres are composed chiefly of the smooth styli. At the surface they break up into densely-packed, radiating tufts of smooth styli, forming a dermal crust. Very numerous loose megascleres are scattered between the fibres of the main skeleton.

*Megascleres*, (*a*) straight, smooth, rather slender styli; evenly rounded off at one end and fairly gradually sharp-pointed at the other; nearly cylindrical; size about 0·23 by 0·0042 mm.; (*b*) spined styli; straight, gradually sharp-pointed, apex free from spines; variable in size, usually rather short and stout, say about 0·1 by 0·0082 mm.

*Microscleres*, very numerous isochelæ. Resembling the ordinary *Clathria* type in general characters but comparatively large and

distinguished by a very thin wing-like expansion or fimbria along each side of the shaft.* Length about 0·022 mm.

*R.N.* 752 (s. 5; "light orange-brown"); 763 (s. 1); 792 (Sorrento Jetty; "greyish-brown"); 801 (s. 1; "orange-brown"); 842 (s. 10); 843 (s. 10).

### *Clathria myxilloides*, n. sp.

Massive, depressed, cake-like. Surface rather uneven; villous with projecting fibres, although the dermal skeleton appears to be intact. Compact, soft, resilient. Pale greyish-yellow in spirit.

*Skeleton*, the main skeleton is a very loose and irregular network of stout, whisp-like, multispicular fibres, mostly running towards the surface. The fibres appear very lax and with little or no obvious spongin. They are made up of the smooth styli, irregularly echinated and accompanied by the spined styli. Between the fibres loose megascleres are abundantly scattered. The dermal skeleton consists of dense, radiating tufts of smooth styli.

*Megascleres*, (*a*) long, straight, slender, smooth styli; evenly rounded at one end and sharply pointed at the other; about 0·3 by 0·0042 mm.; (*b*) spined styli; straight and rather slender, gradually sharp-pointed and abundantly spined all over; about 0·13 by 0·005 mm.

*Microscleres*, tridentate isochelæ, resembling those of *Myxilla*, with strongly-curved shaft. Length about 0·025 mm.

This species at first sight closely resembles *Clathria alata* but differs in the form of the spicules very considerably.

*R.N.* 729 (s. 5).

### *Clathria imperfecta*, n. sp.

Sponge compressed, cake-like, crumbling.

*Skeleton*, a very irregular reticulation of loose, whisp-like, multispicular fibre without obvious spongin, irregularly echinated and accompanied by spined styli, but composed principally of smooth styli. Many spicules are scattered between the fibres, especially spined styli, and at the surface there is a poorly-developed dermal skeleton of loose radially-disposed smooth styli.

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* Whence the name of the species.

*Megascleres*, (*a*) smooth, straight styli, gradually sharp-pointed at the apex, and evenly rounded at the base; size about 0·2 by 0·0062 mm.; (*b*) spined styli; usually straight, tapering gradually to a fine point, richly spined all over; size about 0·1 by 0·005 mm.

This remarkable species, characterised by the entire absence of microscleres, should perhaps be considered as the type of a new genus. As regards external form and the general arrangement of the skeleton and the form of the megascleres it comes very near to *Clathria alata* and *C. myxilloides*.

*R.N.* 376 (18 f; "dull brown orange, yellower below").

### Genus *Ophlitaspongia*, Bowerbank* (emend.)

Usually with strongly-developed horny fibre. Megascleres smooth styli, some of which echinate the horny fibre. Microscleres may or may not be present. External form not honeycombed.

This genus, as thus constituted, will be a very useful one differing from *Clathria* in the smoothness of the echinating styli, and from *Echinoclathria* in the external form. It has been pointed out by Topsent that the first described species of *Clathria (C. coralloides)* has smooth echinating spicules, but the genus was so imperfectly diagnosed by its author that we may accept the views of subsequent writers, who seem to be agreed in regarding the spined styli as characteristic. This view leaves the field open for Bowerbank's *Ophlitaspongia*, of which the type has smooth echinating styli.

Some species of the genus, in which the styli may be replaced by oxea, form an interesting link between the Ectyoninæ and Chalininæ, and I have little doubt that my *Siphonochalina bispiculata*, described in the first part of this catalogue, really belongs near here.

### *Ophlitaspongia subhispida*, Carter, sp.

*Echinoclathria subhispida*, Carter, A.M.N.H., November, 1885, p. 356.

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* Monograph of British Sponges, Vol., II., p. 14.

*Echinoclathria gracilis*, Carter, *op. et loc. cit.*

? *Axinella chalinoides*, Carter, A.M.N.H., November, 1885, p. 358.

? *Axinella chalinoides*, var. *cribrosa*, Carter, A.M.N.H., November, 1886, p. 377.

The sponge is branched, the branches being long and slender, subcylindrical or flattened. The skeleton is reticulate, consisting of strongly-developed horny fibre, in part cored and echinated by smooth styli. In addition to the spicules mentioned by Mr. Carter, I find in B.M. sp. 39 and in B.M. sp. 42 and in R.N. 310, slender toxa present.

*R.N.* 310 (20 f; "dark brownish red"); ? 628 (x, 19 f; "maroon").

*B.M.* sp. 39 ("*Echinoclathria gracilis*, C. type," Reg. 86-12-15-45); sp. 42 ("*Echinoclathria subhispida*, C. type," Reg. 86-12-15-70); ? d. 81 ("*Axinella chalinoides*," Reg. 86-12-15-402).

### *Ophlitaspongia nodosa*, Carter, sp.

*Echinoclathria nodosa*, Carter, A.M.N.H., November, 1885, p. 356.

This species is branching, with the branches nodulated and sometimes anastomosing. The skeleton is reticulate, with well-developed horny fibre. The spicules are smooth styli, in and projecting from the fibre and scattered between. Special echinating spicules can hardly be said to exist, and I have seen no microscleres.

*R.N.* 264 (18 f; "brick red"); 644 (s. 5, 7 f; "crimson, with a very light wash of sepia"); 899 (s. 10).

*B.M.* sp. 41 (*Echinoclathria nodosa*, C. type," Reg. 86-12-15-96).

### *Ophlitaspongia tenuis*, Carter, sp.

*Echinoclathria tenuis*, Carter, A.M.N.H., November, 1885, p. 355.

*Phakellia papyracea*, Carter, A.M.N.H., November, 1886, p. 379.

(Not *Phakellia papyracea*, Ridley and Dendy, Challenger Monaxonida, p. 172).

The sponge is stipitate, thin, flabellate. The main skeleton consists of a fairly regular, rather small-meshed, sub-rectangular network of strongly-developed horny fibre, cored and echinated by smooth, short, stout styli or subtylostyli of variable size. This skeleton is condensed in the central plane. There are also present long and very slender, smooth tylostyli, with well-developed heads. These appear to be very characteristic, they occur in longitudinal whisps and scattered towards the middle of the sponge, and in loose radiating tufts at the surface. No microscleres have been detected. The species is interesting because it shows a structure intermediate between the *Ectyoninæ* and *Axinellidæ*, so that it might, with almost equal justice, be placed in either group. Indeed, I find from examination of the British Museum specimens that Mr. Carter's *Echinoclathria tenuis* and *Phakellia papyracea* are identical.

*R.N.* 287 (18 f; "bright brick red"); 353 (19 f; "venetian red with yellow spots"); 1075 (x A).

*B.M.* sp. 43 ("*Echinoclathria tenuis*, C. type," Reg. 86-12-15-147); d. 88 ("*Phakellia papyracea*," Reg. 86-12-15-231).

### *Ophlitaspongia gabrieli*, n. sp.

Sessile, spreading, encrusting; rising into short mammiform projections, each bearing a smallish vent. Surface uneven, with minutely reticulate dermal membrane in the depressed portions, more or less granular elsewhere. Texture soft, resilient; colour in spirit pale yellow.

*Skeleton*, the main skeleton is a sub-rectangularly meshed network of strongly-developed horny fibre. The primary fibres are about 0·055 mm., thick and sparsely cored with slender styli. The secondary connecting fibres are a little slenderer and without any spicular core. The dermal skeleton consists of sparse tufts of slender styli projecting very slightly beyond the dermal membrane.

*Megascleres*, smooth, straight styli, of two chief sizes, (*a*) comparatively short; hastately and very sharply-pointed at the apex, and evenly rounded off at the base; measuring about 0·09 by 0·0042 mm. These occur pretty abundantly scattered in the soft tissues between the fibres; a very few of them echinate

the fibres; a very few oxea of about the same proportions also occur. The styli coring the main fibres are of about the same length but much slenderer; (*b*) comparatively long; gradually sharp-pointed at the apex, and evenly rounded off at the base; measuring about 0·19 by 0·003 mm.; occurring in the dermal tufts and scattered between the fibres.

*Microscleres*, a very few long, slender oxeote spicules, slightly angulated in the middle, may perhaps represent toxa. They measure up to about 0·25 by 0·002 mm.

I have much pleasure in dedicating this species to Mr. J. Gabriel, to whose dredging operations I am indebted for many Victorian sponges.

*R.N.* 915 (s. 5).

### *Ophlitaspongia axinelloides*, n. sp.

Sponge erect, lobose, stipitate. Vents small, marginal. Surface smooth, minutely reticulate. Colour in spirit pale yellow.

*Skeleton*, the main skeleton is a rather close sub-rectangularly meshed network of strongly-developed horny fibre. The primary lines are about 0·07 mm. thick and pretty abundantly cored by the short, smooth styli, many of which are arranged in an Axinellid manner, with their apices projecting obliquely upwards and outwards from the fibre. The secondary, connecting fibres are a little slenderer, sparsely cored and rarely echinated by scattered styli. Numerous styli are irregularly scattered in the soft tissues between the fibres. The dermal skeleton is not very strongly developed and consists of rather sparse, radiating tufts of styli supported on an underlying reticulation of horny fibre belonging to the uppermost part of the main skeleton.

*Megascleres*, smooth, straight, styli; usually short and stout, evenly rounded and slightly narrowed at one end and tapering gradually to a fine point at the other; measuring about 0·1 by 0·0082 mm. Such spicules are the most abundant in all situations; they are occasionally replaced by sharp-pointed oxea of about the same dimensions, while longer and slenderer styli of variable size occur plentifully scattered amongst them. The latter are sometimes of almost hair-like proportions.

*R.N.* 329 (18 f; "deep blood red").

Genus *Echinoclathria*, Carter.

Sponge made up of a honeycomb-like mass of anastomosing, flattened trabeculæ. Skeleton reticulate, horny, with or without spicules in the fibre. Megascleres smooth, either styli or tylota; smooth echinating styli commonly present. Palmate isochelæ may be present.

*Echinoclathria favus*, Carter.

*Echinoclathria favus*, Carter, A.M.N.H., October, 1885, p. 292.

*Echinoclathria favus*, Ridley and Dendy, Challenger Monaxonida, p. 160, pl. xxxi., figs. 4, 5, 5*a*.

It is rather curious that this species, which would seem, from Mr. Carter's original description and from the "Challenger" Collection, to be not uncommon in Bass Straits, is unrepresented in Mr. Wilson's later collections.

*Echinoclathria glabra*, Ridley and Dendy.

*Echinoclathria glabra*, Ridley and Dendy, Challenger Monaxonida, p. 163, pl. xxix., figs. 11, 11*a*; pl. xxxi., fig. 2.

This species was described from a single specimen collected by the "Challenger" in Bass Straits. Mr. Wilson has added three more.

*R.N.* 691 (s. 7, Queenscliff Jetty); 696 (s. 7, Queenscliff Jetty); 707 (s. 3; "yellowish grey").

*Echinoclathria arenifera*, Carter.

? *Holopsamma laminæfavosa*, Carter, A.M.N.H., March, 1885, p. 212.

*Echinoclathria favus*, var. *arenifera*, Carter, A.M.N.H., November, 1885, p. 350.

The sponge is honeycombed as usual but intensely sandy. The spicules are difficult to make out, apparently smooth, echinating subtylostyli and slender linear spicules only. B.M. d. 54, 55 and 58 all contain proper spicules, while their presence is doubtful in d. 49 and 56.

*R.N.* 308 (20 f; "sandy sponge colour"); 557 (x, 19 f; ochraceous buff"); 698 (s. 7, Queenscliff Jetty); 830 (s. 10); 833 (s. 10); 849 (s. 10).

*B.M.* ? d. 49 ("*Holopsammà laminæfavosa,*" Reg. 86-12-15-420); d. 54 ("*Holopsamma laminæfavosa,*" unregistered); d. 55 ("*Holoposamma liminæfavosa,*" Reg. 86-12-15-491); d. 56 ("*Holopsamma lamina*", Reg. 86-12-15-490); d. 58 (*Holopsamma lamina,*" Reg. 86-12-15-312).

### Genus *Plumohalichondria*, Carter.

Skeleton arranged in plumose columns. Megascleres smooth diactinal and spined monactinal. Typical microscleres isochelæ.

### *Plumohalichondria cæspitosa*, Carter, sp.

*Echinonema cæspitosa*, Carter, A.M.N.H., November, 1885, p. 352.

The massive, proliferous, coralloid external form and columnar structure with the plumose skeleton columns are very characteristic of this species.

*R.N.* 485 (s. 10, 8 f; "salmon colour"); 565 (s. 10, 8 f; "orange"); 664; 901 (s. 10).

*B.M.* sp. 45 ("*Echinonema cæspitosa,* C· type," Reg. 86-12-15-97).

### *Plumohalichondria uncifer*, n. sp.

Sponge thin, encrusting, with minutely conulose surface and columnar structure. Colour in spirit pale yellow.

*Skeleton* composed of short, stout, plumose columns, running from the base to the dermal membrane and branching slightly in their course. These columns consist chiefly of spined styli, whose basal portions are connected together by much spongin; accompanied by a few slender oxea. The oxea become more abundant towards the surface, radiating off from the plumose columns in tufts to the dermal membrane.

*Megascleres*, (*a*) long, straight, slender oxea; smooth and rather abruptly pointed; measuring about 0·16 by 0·0027 mm.; (*b*) spined styli; rather slender, straight or slightly curved, tapering very gradually to the apex, the neighbourhood of which alone is free from spines; varying much in size, about 0·18 by 0·0083 mm. when fully grown.

*Microscleres*, (*a*) robust tridentate isochelæ, with strongly-curved shaft and short blunt teeth. These spicules vary up to about 0·04 mm. in length. What I take to be young forms are extremely abundant. The smallest are very slender and the developing teeth gives them a peculiar appearance; (*b*) rather slender, simple and contort sigmata; measuring when fully grown about 0·033 mm. from bend to bend. Both forms of microscleres are very abundant.

This specices appears to be nearly related to *P. cæspitosa*, but is distinguished by the thin habit, the more robust chelæ and the presence of abundant sigmata.

*R.N.* 1047 (x B).

### *Plumohalichondria gravida*, n. sp.

Massive, compact, solid. Intensely and coarsely sandy. Sand arranged in stout vertical columns ending in slight conuli on the surface. Surface subglabrous between the sandy points. Vents rather large, scattered, with wide, vertical oscular tubes. Texture hard, friable. Colour in spirit sandy brown, with grey flesh.

*Skeleton*, composed chiefly of sand, with numerous spined styli echinating the sand grains, and other spicules scattered between. At the surface the oxea form radiating tufts.

*Megascleres*, (*a*) straight, smooth, slender oxea, rather abruptly pointed; about 0·14 by 0·0027 mm.; (*b*) short, slender, straight, finely pointed and entirely spined styli; about 0·06 by 0·004 mm.

*Microscleres*, (*a*) tridentate isochelæ, up to about 0·023 mm. long, but commonly much smaller; (*b*) rather slender, simple and contort sigmata, about 0·03 mm. from bend to bend.

*R.N.* 716 (s. 8); 881 (s. 9).

### *Plumohalichondria incrustans*, Carter, sp.

*Echinonema incrustans*, Carter, A.M.N.H., November, 1885, p. 353.

*Plumohalichondria mammillata*, Carter, A.M.N.H., November, 1885, p. 355.

*Plumohalichondria mammillata*, Ridley and Dendy, Challenger Monaxonida, p. 156, pl. xxx., figs. 4, 4*a*; pl. xlvii., figs. 4, 4*a*.

The British Museum specimens show conclusively that *Plumohalichondria mammillata* is a mere synonym of *Echinonema incrustans.*

*R.N.* 496 (s. 10, 8 f; "scarlet vermilion").

*B.M.* sp. 46 ("*Echinonema incrustans*, type," Reg. 86-12-15-123); d. 98 ("*Plumohalichondria mammillata*, unregistered"); d. 107 ("*Plumohalichondria mammillata*," Reg. 86-12-15-249).

### *Plumohalichondria arenacea*, Carter.

*Plumohalichondria arenacea*, Carter, A.M.N.H., November, 1885, p. 367.

This is probably merely a variety of *P. incrustans*, of very robust habit, with sandy fibre and dermal crust of spined styli. There is no tangible difference in the spiculation of the two. The external form varies from massive to flabellate.

*R.N.* 323 (18 f; "pale grey buff with a red tint on the projecting parts"); 528 (s. 1, 14 f; "between vermilion and ochraceous-rufous"); 675 (s. 5); 682 (s. 5); 708 (s. 5; "flesh to brick red"); 924 (s. 1); 974 (s. 5); 1084 (x A).

*B.M.* sp. 67 (*Plumohalichondria arenacea*, C. type," Reg. 86-12-15-80).

### *Plumohalichondria purpurea*, Carter,

*Plumohalichondria plumosa*, var. *purpurea*, Carter, A.M.N.H., November, 1886, p. 376.

This is a remarkable species intermediate in characters between *Plumohalichondria* and *Echinodictyum;* it differs from the typical *Plumohalichondria* in that the microscleres are entirely wanting. The name was unfortunately chosen because the purple colour is not characteristic and was probably adventitious in the type. There is only one specimen in the collection and that is extremely irregular, massive, proliferous; with conulose and rugose but subglabrous surface, and firm, compact texture. The colour in spirit is pale yellowish-grey; in life it was buff.

*R.N.* 759 (s. 1; "buff.")

*B.M.* sp. 47 ("*Plumohalichondria plumosa*, var. *purpurea*. Carter. Type of var.," Reg. 86-12-15-127).

*Plumohalichondria tenuispiculata*, n. sp.

Sponge forming a thin crust, rising up into small, irregular, branched, coralloid processes. Surface very uneven. Consistence pretty firm and compact. Nearly white in spirit.

*Skeleton*, very confused, consisting of very abundant slender spicules, in great part scattered quite irregularly but often collected into loose, whisp-like, irregularly-branching fibres, with no obvious spongin. The axial portions of the fibres consist of the slender oxea and they are irregularly echinated by the spined styli.

*Megascleres*, (*a*) very slender, long, straight oxea, measuring about 0·2 by 0·002 mm.; (*b*) comparatively short, straight, spined styli; gradually and finely pointed, spined all over but most abundantly at the base; size about 0·08 by 0·004 mm.; (*c*) very long and slender spined styli, gently curved and drawn out gradually into long fine points, the spines dying away towards the apex; measuring up to about 0·25 by 0·0027 mm. Intermediate forms of spined styli are also met with.

The species is nearly related to *P. purpurea*, but differs in the much more slender spicules and perhaps also in the external form. There are no microscleres.

*R.N.* 1024 (x B).

Genus *Echinodictyum*, Ridley.

Skeleton usually reticulate. Megascleres smooth diactinal in the fibre and spined monactinal echinating the fibre. Smooth styli may also be present. No microscleres.

*Echinodictyum ridleyi*, n. sp.

Sponge lamellar to flattened digitate; may be stipitate, proliferous and bushy. Lamellæ usually thin. Vents small and marginal. Surfaces usually smooth and glabrous. Texture compressible, resilient, tough. Colour in spirit pale greyish yellow.

*Skeleton*, the main skeleton is an irregular network of well-developed horny fibre of pale colour, cored by numerous smooth oxea in the main fibres. These spicules are commonly arranged in a very loose, whispy manner; they may be absent from some

of the short connecting fibres. The spined echinating styli are but sparingly developed. The smooth styli are very irregular in their distribution; they may be abundant towards the dermal surface, projecting obliquely from the horny fibre in a plumose fashion. There is usually no special dermal skeleton, but in one specimen there are loose dermal tufts of the slender oxea which give the surface a hispid character.

*Megascleres*, (*a*) long, smooth, straight, slender oxea; rather abruptly pointed; size about 0·27 by 0·0042 mm.; (*b*) very slightly curved, smooth, gradually and usually finely-pointed styli or subtylostyli; size about 0·19 by 0·0072 mm.; (*c*) spined styli; short, straight, gradually sharp-pointed, sparingly spined; size about 0·1 by 0·006 mm.

*R.N.* 269 (20 f; "dull brownish red"); 633 (x, 19 f; "ochraceous-rufous"); 928 (x A); 1033 (x B).

### *Echinodictyum spongiosum*, n. sp.

Encrusting, irregular; may be massive, proliferous, lobulated. Vents minute or of fair size, scattered. Texture soft and spongy. Colour in spirit pale greyish-yellow.

*Skeleton* a very loose network of multispicular, whispy fibres, mostly branching off from one another at acute angles and running towards the surface. The tylote spicules, of which the fibre is chiefly composed, are invested and held together by a considerable amount of very pale-coloured spongin, and are here and there echinated by spined styli. The fibres divide up into almost single spicules as they approach the surface, but there is no properly developed dermal skeleton. The whole skeleton is very lax, and a good many loose spicules are scattered between the fibres.

*Megascleres*, (*a*) straight or nearly straight, slender tylota; with cylindrical shaft and small ovoid head at each end; size about 0·19 by 0·0028 mm.; (*b*) spined styli or substylostyli; straight, sharply pointed, with small sharp spines irregularly distributed but most abundant at the base; size about 0·087 by 0·0042 mm. As compared with the tylota these spicules are very scarce, and their presence might easily be overlooked.

*R.N.* 790 (Sorrento Jetty; "sponge grey"); 946 (s. 9).

*Echinodictyum arenosum*, n. sp.

Massive, depressed, spreading. Upper surface even, almost flat, with meandriniform sandy pattern and minutely-reticulate dermal membrane between. Vents minute, scattered. Incompressible, intensely sandy and friable, with radiately columnar structure, due to the arrangement of the sandy tracts. Colour in spirit pale grey and sandy.

*Skeleton*, composed chiefly of sand arranged in dense tracts as above described. Between these sandy tracts are scattered numerous slender tylostrongyla or tylota, without definite arrangement except towards the surface, where very loose, whisp-like fibres terminate in a dense layer of short, radiating tufts which support a small-meshed reticulate dermal skeleton of abundant tangentially-placed tylostrongyla or tylota. The sand grains in the interior of the sponge are sparsely echinated by spined styli.

*Megascleres*, (*a*) tylostrongyla; straight or slightly curved, slender, with very slightly-developed head at one end and bluntly rounded off at the other, or with a small head at each end (tylote); measuring about 0·19 by 0·003 mm.; (*b*) spined styli or tylostyli; straight, slender, minutely spined all over, gradually and finely pointed; size about 0·083 by 0·003 mm.; scarce.

*R.N.* 925 (s. 1).

Genus *Raspailia*, Nardo.

Sponge usually consisting of long slender branches; with a dense central axis of spiculo-fibre containing much spongin, from which loose tufts of spicules radiate to the surface. Smooth monactinal (sometimes diactinal) megascleres are present, and also spined echinating styli*. No microscleres.

I agree with Topsent in removing this genus from the *Axinellidæ* to the *Ectyoninæ*, although it is certainly intermediate in structure between these two groups.

*Raspailia pinnatifida*, Carter, sp.

*Dictyocylindrus pinnatifidus*, Carter, A.M.N.H., November, 1885, p. 353.

* Often extremely rare and hard to detect, perhaps sometimes absent.

? *Axinella chalinoides*, var. *glutinosa*, Carter, A.M.N.H., November, 1885, p. 359.

*Axinella setacea*, Carter, A.M.N.H., November 1885, p. 359.

? *Axinella cladoflagellata*, Carter, A.M.N.H., December, 1886, p. 464.

The sponge has the typical external form of the genus, consisting of long, slender "rat's-tail" branches. The spined echinating styli are very scarce, but I have found them also in the type of *Axinella setacea* from the British Museum.

*R.N.* 385; 443 (s. 9, 16 f; "seal brown"); 851 (s. 9); 888 (s. 9).

*B.M.* sp. 74 ("*Dictyocylindrus pinnatifidus*, C. type," Reg. 86-12-15-50); sp. 66 ("*Axinella setacea*, C. type," Reg. 86-12-15-61); ? d. 82 ("*Axinella cladoflagellata*, seu *A. chalinoides*, var. *glutinosa*," Reg. 86-12-15-407).

*Raspailia atropurpurea*, Carter, sp.

*Axinella atropurpurea*, Carter, A.M.N.H., November, 1885, p. 359.

The sponge consists of a stipitate bunch of short branches of a dark purple colour, retained for a long time in spirit. The arrangement of the skeleton is that usually found in the genus, with larger stylote or tylostylote megascleres embedded in much spongin in the interior, and much smaller styli in radiating tufts at the surface. The original description makes no mention of the spined echinating styli, which are fairly numerous and which I have found also in the type specimen from the British Museum. These are short, straight, usually bluntly-pointed, and covered with small spines all over; they measure about 0·083 by 0·006 mm.

*R.N.* 638 (x, 19 f; "seal brown, very dark").*

*B.M.* sp. 63 ("*Axinella atropurpurea*, C. chief type," Reg. 86-12-15-1).

*Raspailia vestigifera*, n. sp.

The sponge consists of a stipitate bunch of few, slender, rather short, stiff, erect, subcylindrical branches. The surface is

* In spirit the colour is dark purple, fading to brown on the outside.

strongly hispid. The texture is firm and very tough, and the colour in spirit is rather dark brown.

*Skeleton*, the skeleton consists of a very dense central axis of laminated brown spongin, apparently originally made up of a close irregular network of stout horny fibres. This central axis is very thick and is continued in short, stout, radiating fibres towards the surface. Imbedded in this abundant horny matrix are very numerous large oxeote spicules, mostly lying more or less parallel to the long axis of the sponge, but many curving outwards towards the surface in the radiating fibres. At the surface are arranged, at fairly regular intervals, beautiful radiate tufts of small slender megascleres. From the centre of each of these tufts a very large oxeote spicule projects outwards, approximately at right angles to the surface of the sponge and imbedded in the sponge for only about a quarter of its length.

*Megascleres*, (*a*) long and rather slender, gently-curved oxea, sharply and gradually pointed at each end and resembling those of *Halichondria*; size about 0·9 by 0·013 mm.; found in the horny fibre in the interior of the sponge with many smaller ones; (*b*) the very large oxea of the surface, in shape like those of the interior, but measuring about 1·47 by 0·055 mm.; (*c*) the spicules of the surface tufts; sub-oxeote or stylote, gradually sharp-pointed at the outer end, but more or less rounded off at the inner; long, slender, gently curved; size about 0·35 by 0·004 mm.; (*d*) small spined styli; short, straight, gradually and finely pointed and minutely spined all over; size about 0·066 by 0·004 mm.; very rare, echinating the horny fibre in the interior of the sponge; probably to be regarded as merely vestigial structures.

*R.N.* 655 (x, 20 f; "bottle green with a wash of sepia").

## *Raspailia cacticutis*, Carter, sp.

*Dictyocylindrus cacticutis*, Carter, A.M.N.H., November, 1885, p. 354.

This is a very remarkable species, easily recognisable by its cactiform external appearance and nearly black colour. The skeleton is composed chiefly of an irregular network of very stout horny fibre, sometimes with and sometimes without axial

spicules, and more or less abundantly echinated by short spined styli. The large, smooth styli or tylostyli occur most abundantly in the strongly-developed surface projections, accompanied by much spongin. There are no surface tufts of spicules, but the dermal membrane is glabrous and has a beautiful reticulate appearance between the projections.

*R.N.* 346 (20 f; "dark grey-brown"); 399; 425 (x, 19 f; "clove brown, with a slight green tinge); 1157 (x); 1174.

*B.M.* sp. 70 ("*Dictyocylindrus cacticutis*, C. type," Reg. 86-12-15-120).

### Genus *Fusifer*, n. gen.

Sponge massive, with fistular projections. The only known species has an intensely sandy body, covered by a thin dermal membrane. Megascleres monactinal, smooth and spined styli or tylostyli. Characteristic microscleres microxea, to which others may be added.

This is a very remarkable genus indeed, strongly characterised by its external form and by the beautiful spindle-shaped microscleres (microxea). The external form and the character of the dermal membrane approach those of *Histoderma*, but the well-developed and abundant spined echinating styli show it to be an undoubted Ectyonine.

### *Fusifer fistulatus*, n. sp.

Sponge consisting of a massive, irregular, intensely and coarsely sandy body; invested in a thin, delicate membrane rising up above into rather short, hollow, thin-walled processes, some widely open and some closed. Body sand-coloured, projections pale yellow in spirit.

*Skeleton*, the main skeleton of the body is a dense agglomeration of sand grains with spicules in the interstices. The sand may be arranged in stout, flattened columns, running vertically upwards and appearing on the surface in the form of meandering sandy tracts. Many of the sand grains are abundantly echinated by spined styli. The other spicules are scattered irregularly between them, but the tylostyles may be partly collected into stout fibres running towards the surface. The dermal skeleton is a very irregular reticulation, either of single spicules (tylostyli)

placed tangentially and crossing one another in every direction, or of similar spicules more or less collected into loose fibres.

*Megascleres*, (*a*) long smooth tylostyli, with a slightly-developed oval head at one end and gradually sharply pointed at the other; commonly more or less curved; size variable, say about 0·54 by 0·007 mm. when fully developed; (*b*) spined styli; straight or slightly curved, slender, gradually and finely pointed, covered pretty evenly all over with small spines; commonly about 0·07 by 0·003 mm. but sometimes nearly twice as long.

*Microscleres*, (*a*) smooth, straight, spindle-shaped microxea, tapering equally from the middle to a fine point at each end; size about 0·046 by 0·002 mm.; pretty abundantly scattered between the sand grains and in the dermal membrane; (*b*) very slender smooth toxa varying immensely in length (measured up to about 0·3 mm., but many only about 0·013 mm. long); abundant.

*R.N.* 6; 501 (x, 20 f; "drab, the projections ochre-yellow"); 683 (s. 9); 1045 (x B).

### Genus *Acarnus*, Gray.

Megascleres styli and cladotylota ("grapnel-spicules"), to which tylota may be added. Microscleres may be present in the form of palmate isochelæ and toxa.

### *Acarnus tenuis*, n. sp.

This species occurs in the form of small thin crusts on the surface of other sponges. On one specimen of *Clathria typica* (R.N. 1072), for example, there are dozens of such crusts. They are subcircular or irregular in outline, and the largest are only about a quarter of an inch in diameter. They are thin and flat and have no visible vents. In spirit they are of a pale yellow colour. I have also found them on *Plumohalichondria arenacea* (R.N. 974) and on *Tedania digitata* (R.N. 991).

*Skeleton*, composed of a very loose network of irregularly-interlacing spicules, with no visible spongin.

*Megascleres*, (*a*) stylote or strongylote (perhaps sometimes subtylostylote); straight, smooth, long and very slender, measuring about 0·18 by 0·002 mm.; comparatively scarce; (*b*) cladotylote, straight (or nearly so), long and very slender; with a

well-developed ovoid head at one end and several well-developed, recurved, sharp teeth at the other. The usual number of teeth appears to be five, but I should doubt if this is constant. The spicule is about 0·16 mm. long, and the shaft is scarcely 0·002 mm. thick for the greater part of its length, but increases in diameter at each end; the teeth are about 0·004 mm. long. These "grapnel-spicules" are not echinating; indeed, there is no fibre for them to echinate, but they are extremely numerous. They occur scattered irregularly and also in loose bundles, in which they lie parallel to one another, with some of the grapnels at one end of the bundle and some at the other, each spicule extending the whole length of the bundle, or very nearly so.

As might naturally be expected, a few spicules of the sponge on which the specimen has grown may occur as foreign bodies. I have found no microscleres. The soft tissues are densely charged with spherical cells about 0·006 mm. in diameter.

This is one of the most remarkable sponges in the entire collection.

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ART. IV.—*Evidence of the Existence of a Cambrian Fauna in Victoria.*

By R. ETHERIDGE, Junr., Corr. Memb.

(Curator of the Australian Museum, Sydney).

(With Plate I.)

[Read 8th August, 1895.]

Geological research has, so far, made known in Australia and Tasmania three groups of rocks believed to be of Cambrian age, as evidenced by Palæontological evidence.

The beds in question, in the order of their reported discovery, are :—

1. Caroline Creek beds, Mersey River District, Tasmania, containing Trilobites and a limited Molluscan fauna.*
2. York Peninsula Series, South Australia, and northern extension of the same in the Flinders Ranges, with Trilobites, Mollusca and a low form of Coral life.†
3. Kimberley beds, N.W. Australia, with a Trilobite, and a possible Pteropod.‡

The locality of the Kimberley fossils is not definitely known. I have searched both the late Mr. E. T. Hardman's Reports,§ without finding any record of this occurrence.

Until the appearance of Messrs. Selwyn and Ulrich's "Notes on the Physical Geography, Geology and Mineralogy of Victoria,"|| no direct reference to rocks older than Silurian in Victoria had been made. Therein Sir Alfred (then Mr.) Selwyn contented himself by remarking that westward of Melbourne "there seems to be a very gradually descending series, and towards the extreme

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* See T. Stephens, Papers and Proc. Roy. Soc. Tas. for 1874 [1875], p. 27; Etheridge, Junr., *Ibid*, for 1882 [1883], p. 151.

† See H. Woodward, Geol. Mag., 1884, I. (3), p. 343; Etheridge, Junr., Trans. Roy. Soc. South Australia, 1890, xiii., Pt. I., p. 10; Pritchard, *Ibid*, 1892, xv., Pt. II., p. 179; Tate, *Ibid*, p. 183.

‡ See Foord, Geol. Mag., 1890, vii. (3), p. 98.

§ 1st and 2nd Reports on the Geology of the Kimberley District, Western Australia (folio, Perth, 1884-85).

|| 8vo. Melbourne, 1866 (p. 10).

limits of the colony, west of the Grampians, a group of strata is exposed consisting of foliated micaceous and chloritic talcose, and serpentinous schists. . . . . Little is yet known of the relations of these beds, and whether they represent a series older than lower silurian . . . . is uncertain."

In the "Table of Geological Formations" given in Murray's "Geology and Physical Geography of Victoria"* these beds are spoken of as "Crystalline (Azoic)." He further speaks of the Lower Cambrian and Laurentian as "not yet recognised and probably not occurring in Victoria," and says: † "The metamorphic rocks of the series, among which may possibly be representatives of the Lower Cambrian and Laurentian groups, appear between the Wannon and Glenelg Rivers westward of the Grampians . . . . and in the north-eastern or Omeo district . . . . but in geological age they appear to be Silurian as regards the period of their deposition." From this it would appear that up to 1887 no evidence, beyond that of mere speculation, existed of true Cambrian rocks in Victoria. Sir F. McCoy, however, in 1892 published the following remarks: ‡ "Some specimens from a recently-observed group of rocks in the Heathcote district, which Mr. E. J. Dunn believed to be older than Silurian, were submitted to me to determine whether the markings were of organic origin. These were cylindrical, flexuous markings, from one to two, or scarcely three, inches in length, mineralogically different from the matrix. These markings are not organic in themselves, but are usually attributed to annelid burrows, and are common in Cambrian rocks. . . . . There is no reason for supposing from these specimens that the rock is older than Cambrian or Lower Silurian." I know of no other direct evidence of the supposed occurrence of Cambrian rocks in Victoria beyond this. Quite recently, however, Mr. E. Lidgey has expressed the opinion that Pre-Silurian rocks existed within the boundaries of Quarter Sheet No. 80, N.W. (Parishes of Heathcote, Costerfield, Knowlesley), in the neighbourhood of Mount Ida, but I am not aware that this was substantiated

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* 8vo. Melbourne, 1887 (p. 16).

† *Loc. cit.* p. 33.

‡ Report on Palæontology of the Geological Survey for the Year 1891. *Ann. Report Secy. for Mines Vict.* for 1891 [1892], p. 30.

on anything more than mere stratigraphical evidence. Mr. Lidgey speaking of the metamorphic rocks of the area in question says:* "These rocks have already been reported on by Mr. E. J. Dunn, who classes them as Pre-Silurian," but I regret that I cannot at this moment call to mind the report of the latter gentleman. The Pre-Silurian rocks in question, Mr. Lidgey further adds, are succeeded by others of Lower Silurian age, occupying "rather less than one-fourth of the area mapped in this quarter-sheet, lying to the west of the Mount Ida Range, overlying the metamorphic rocks, and being covered on the west by glacial conglomerate (Mesozoic)." These micaceous mudstones are further stated to contain "casts of Trilobites." Whether the specimens about to be described are from the metamorphic area, or from the supposed Lower Silurian mudstones, I am unable to say, but I presume from the latter.

Again, Mr. W. H. Ferguson, reporting on the rocks at Dookie, says:† "The rocks which outcrop at Dookie township appear to belong to the same formation as a series of very ancient rocks which occur in the Heathcote district. They are quite distinct from the Silurian formation of the gold-fields, or from the granite and metamorphic rocks of the north-eastern district, or those of the county of Dundas." Lastly, Mr. James Stirling, in "Notes on the Silver Deposits and Limestone Beds of Waratah Bay,"‡ remarks that "the sedimentary deposits at Point Grinder, between Cape Liptrap and Waratah Bay, rest unconformably under [*sic*] hard felsitic rocks. . . . These may be either Silurian or Pre-Silurian." In sketch section No. 1, on the opposite page of this Report, these beds are indicated as Cambrian, pure and simple. On the next plate but one—a sketch of Waratah Bay—the same are presumedly given as Pre-Silurian, but again on the succeeding plate to this Mr. Stirling reverts to the use of the word Cambrian.

In January of last year (1894), Mr. Ferguson was good enough to forward to me a few Trilobite remains from near Heathcote, for an opinion as to their identity. In a letter, dated 19th January, he says:—"We think the rock is Lower

* Geol. Survey Victoria, Progress Report, viii., 1894, p. 44.

† Progress Report viii., *l.c.*, p. 44.

‡ *Ibid*, p. 68.

Silurian in which they occur." On 12th April of the same year Mr. Ferguson forwarded additional material, with the permission of Mr. R. A. F. Murray, Government Geologist. In this communication he remarked:—"The fossils were found and collected by myself in a very limited outcrop of shale near Heathcote. The rock is regarded by Mr. E. J. Dunn as Lower Silurian. It occurs between L.S. slates and a bed of conglomerate and breccia, and the fossiliferous U.S. sandstone beds of Mount Ida." On the 13th April, Mr. G. Lidgey kindly supplemented these fossils with others from the same locality—"N. 13° W. of Mount Ida, 230 chains."

On receiving these Trilobite remains, I at once saw that they had the aspect of very old forms, but neither the collections nor works of reference then at my command enabled me to determine their systematic position with accuracy. Grasping the fact that a very large amount of work amongst Cambrian Faunas had been accomplished by our American co-workers, I sent sketches, very carefully prepared by Mr. P. T. Hammond (late of the Geological Survey of New South Wales), to Mr. C. D. Walcott, Director of the U.S. Geological Survey, who has laboured very extensively amongst the life of these old rocks. In due time his reply came, to the effect that the "general facies of the specimens is so much like that of the Middle Cambrian Fauna, that I should not hesitate, were it found in America, to include it within it!" The sketches further impressed Mr. Walcott as representing forms such as occur in the slates of the Middle Cambrian of Newfoundland, New Brunswick, and the Rocky Mountains. In a second communication the same eminent authority observed:—"The fossils undoubtedly belong to the Middle Cambrian Fauna, as they are not of the type found in the Upper or Lower Cambrian." One of the sketches sent to him, Mr. Walcott definitely referred to the type of *Olenoides quadriceps*, Hall and Whitfield, sp., a Middle Cambrian species. This opinion, emanating from so high an authority as Mr. Walcott, cannot but have due weight.

The Trilobite remains consist wholly of portions of cephalic shields—the glabella—and pygidiums, with the exception of one or two indistinct fragments of free cheeks. They are all simply decorticated specimens, without any trace of the original test remaining, but even in this condition are fairly well preserved.

I have submitted these fossils to a most careful examination and long consideration, and having exhausted all means of comparison at my disposal, the conclusion is forced on me that they represent to us in Australia, at least, an undescribed genus. Neither do the specimens seem absolutely in accord with any of the American or European genera, descriptions of which are available. Under these circumstances, I propose describing the Heathcote Trilobites under the new name of *Dinesus*,* and the trivial appelation of *ida*, with the view of recording their place of occurrence. The combined generic and specific description will be followed by some observations on the alliances of the new genus.

DINESUS IDA, *gen. et sp. nov.*

*Chars.*—Cephalic shield sub-semicircular; frontal border raised, nearly straight centrally, separated from the glabella and fixed cheeks by a frontal furrow. Glabella oblong, or long oval, slightly convex, straight-sided, and rounded in front; no furrows; basal circumscribed lobes pyriform, separated completely from the glabella by deep grooves; axial grooves very wide and deep, bifurcating near the fore-end of the glabella, one branch proceeding round the latter and joining the frontal groove, the other round the fixed cheeks on each side, leaving between them and the frontal groove somewhat triangular circumscribed lobes. Fixed cheeks more or less elongately triangular, wider behind, very gently convex; eye-lobes small, slightly projecting; ocular ridges extending obliquely across the fixed cheeks to the anterior corners of the glabella; facial sutures convex in front of the eyes, curving inwards and cutting the frontal border in line with the outer edge of the fore circumscribed lobes, and, posterior to the eye-lobes convex also, dividing the posterior border of the head-shield near the position of the genal angles. Neck ring strong, convex, and devoid of a spine; neck furrow wide and flattened, the lateral furrows similar. Surface, although devoid of the test, frosted with minute granules.

Pygidium sub-semicircular to obtusely triangular, truncate behind; axis flattened, of five segments; pleuræ flattened, of a

* ἡ νησος an island, and δι—in allusion to the two basal circumscribed lobes.

similar number of coalesced segments, with a flattened limb produced into five or six short somewhat posteriorly-directed spines on each side.

This description, although imperfect in many respects, must suffice for the present, as it embodies all that can be gleaned from the specimens. For instance, we know nothing of the thorax, whilst the form of the free cheeks and condition of the genal angles, spined or not spined, is doubtful. The all-important points to be noted, however, are the facial sutures, simply convex before and behind the eyes, the peculiarly squarish-oblong outline of the glabella, triangular fixed cheeks, and the very straight run of the axial grooves, together with the entire absence of glabella grooves. These characters are supplemented by the presence of the anterior and posterior distinctly circumscribed lobes. The eye-lobes are certainly small and non-olenelloid in appearance. Associated with these glabellæ are pygidiums possessing few segments, and a fimbriated margin. The presence of a pleural groove is questionable.

The two pygidiums figured (Pl. I., Figs. 5 and 6) differ slightly in outline, the smaller being sharper at the anterior lateral angles, and more generally triangular in shape; this last point, however, may be only a matter of preservation. Furthermore, there are in one (Pl. I., Fig. 5) five lateral spines extending from the limb, and in the other (Pl. I., Fig. 6) six similiar appendages. Possibly the two may represent distinct species, but at this early stage of the enquiry it is impossible to arrive at a satisfactory conclusion.

The above points are those it will be necessary to use in comparing the Heathcote fossils with probable allies, or genera to to which they might possibly be referable. The genera it is my intention to bring into comparison with the fossils, irrespective of horizon within the Cambrian system, are: *Ptychoparia*, Corda; *Liostracus*, Angelin; *Solenopleura*, Angelin; *Bathyurus*, Billings; *Lloydia*, Vogdes; *Olenoides*, Meek; *Protypus*, Walcott; *Avalonia*, Walcott; and *Dorypyge*, Dames.

Although the form of the glabella in some apparently aberrant forms of *Ptychoparia* is similar to that in *Dinesus*, the pronounced strength of the glabella furrows, and the direction of the facial suture in the type species, *P. striatus*, Emmrich,

sp.,* curving as it does outwards anterior to the eyes, and from the glabella, will, I think, at once debar the Victorian fossils from incorporation in that genus, to say nothing of the entire margin of the pygidium in *Ptychoparia*. It is true that in a few species of the latter a glabella and fixed cheeks occur akin somewhat to those of *Dinesus*, for instance in the Lower Cambrian *P.? Fitchi*, Walcott.† The latter, however, departs in a very marked manner from the regular *Ptychoparia* type, and resembles our fossils in the "elongate, unfurrowed glabella, wide fixed cheeks, and granulose surface," and apparent absence of glabella grooves.

In *Liostracus* the similarity in the square-oblong outline, and unfurrowed state of the glabella in the type species, *L. aculeatus*, Angelin, and *L. muticus*, Angelin,‡ to that in *Dinesus* is strong, but the facial suture is organised on the same plan as in *Ptychoparia*, although, perhaps, to a lesser extent. Still, there is no trace either in *Ptychoparia* or *Liostracus* of the circumscribed lobes, and the pygidium in the latter again presents an entire margin.

*Solenopleura*, as exemplified by the type species *S. holometopa*, Angelin,§ possesses facial sutures as different to those of *Dinesus* as those of *Ptychoparia*. But Mr. Walcott has described two doubtful species, *S. ? nana*, Ford, and *S. ? tumida*, Walcott,‖ that certainly appear to be near our Trilobite, although Lower Cambrian forms, and which he admits "appear to belong to a genus distinct from the typical species of *Solenopleura*." One in particular (*S. ? tumida*) has small circumscribed lobes at the hinder portion of the glabella, moderately straight and parallel axial furrows, and small eye-lobes, but with fixed cheeks hardly as wide as in our specimens, and no frontal furrow to speak of. *S. ? nana*, on the other hand, possesses the latter, but no circumscribed lobes. In typical *Solenopleuræ* the margin of the pygidium is again entire.

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* See Barrande, Syst. Sil. Boheme, 1852, I., t. 14, f. 1-7; Walcott, Bull. U.S. Geol. Survey, 1884, x., t. 6, f. 4.

† 10th Ann. Report U.S. Geol. Survey, 1890, p. 650, t. 96, f. 5.

‡ Pal. Scandinavica, 1854, Pt. II., p. 27, t. 19, f. 2 and 3.

§ Pal. Scandinavica, Pt. II., 1854, p. 26, t. 18, f. 8.

‖ 10th Ann. Report U.S. Geol. Survey, 1890, p. 658, t. 98, f. 1 a-c, 2, 3, 3a.

In connection with the last-named genus, a very interesting group of Trilobites described by the late Mr. Billings as *Bathyurus** must be referred to. Unfortunately, many of the species placed by Billings in *Bathyurus* seem to belong to other genera; certainly the earlier described species† differ a good deal from the later, although Vogdes, in his admirable "Bibliography of the Palæozoic Crustacea" (2nd edition),‡ retains most of them under the old name. Walcott, however, remarks§: "Solenopleura appears to be of the same character as many of the species placed under the genus Bathyurus by Mr. Billings, and I think can be used for such forms as *Bathyurus gregarius*, Billings, and nearly all the species referred to the genus Bathyurus from the Cambrian."

Many of Billings' *Bathyuri*, more especially the later-described ones, such as *B. capax*, *B. dubius*, *B. Saffordi*, *B. Cordai*, and *B. quadratus*,‖ possesses the same square-oblong glabella as *Dinesus*, but comparatively small fixed cheeks, and quite different facial sutures, the latter being straight and almost parallel to the axial grooves. The same objection also applies to those that I have previously mentioned in the case of other Trilobites, viz.—the entire absence of the circumscribed lobes. There is one species, however, *B. bituberculatus*, Billings,¶ that possesses these lobes at the base of the glabella, and on this account has been separated by Capt. Vogdes as a distinct genus, under the name of *Lloydia*.†† Indeed, perhaps, the before-mentioned Trilobite, *Solenopleura ? tumida*, in which the basal lobes are also developed, will fall into *Lloydia* as well, although it must be mentioned that in *S. ? tumida* there are ocular ridges, whilst in Billings' species these are not represented. In the absence of these ocular ridges and the anterior circumscribed lobes, and its perfectly concave facial sutures, *Lloydia* differs essentially from *Dinesus*.

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* Pal. Foss. Canada, Pt. 5, 1865, p. 409.

† Canadian Nat. and Geol., 1859, iv., p. 364.

‡ Occasional Papers, Californian Acad. Sci., 1893, iv., p. 280.

§ Bull. U.S. Geol. Survey, 1884, No. 10, p. 36.

‖ Pal. Foss. Canada, Pt. V., 1865, p. 409, 411.

¶ Pal. Foss. Canada, Pt. V., 1865, p. 409, f. 391.

†† Bull. U.S. Geol. Survey, 1890, No. 63, p. 97.

In *Olenoides*, Meek, taking the type species, *O. typicalis*, Walcott,* I fail to trace any resemblance to our fossils, for, although the glabella is square-oblong, with parallel straight sides, the furrows on the glabella are well-marked; there are no circumscribed lobes; the eye-lobes are very long, approaching those of *Olenellus*, whilst the fixed cheeks and facial sutures are quite unlike those of *Dinesus*. On the other hand, the pygidium in *Olenoides* is provided with spines along the margin. When, however, we examine *O. quadriceps*, Hall and Whitfield, sp., the form indicated by Mr. Walcott in his letters to me, the resemblance is very much stronger. There is the same almost quadrate, or square-oblong glabella, straight parallel sides, small eye-lobes, but with faint grooves on the glabella, and no circumscribed lobes. Whilst admitting a resemblance, it does not seem to me to be of that intimate character necessary for the incorporation of our specimens in the same genus with *O. quadriceps*. At the same time the latter does not strike me as possessing much in common with *Olenoides*, as typified by *O. typicalis*, Walcott.

Dames refers *O. quadriceps* to his genus *Dorypyge*;† but Walcott‡ thinks that the latter may be only synonymous with *Olenoides*. As defined by its author, *Dorypyge* possesses three pairs of glabella furrows, and a facial suture not unlike that of my proposed new genus, but without any trace of circumscribed lobes. On the other hand the margin of the pygidium, as in *Dinesus*, is spined, and closely allied to that of the latter. As regards *Dorypyge* generally, Mr. Walcott makes the following remarks:§ "I have placed the two species|| under the genus Olenoides while waiting for proof of the character of the border of the pygidium of the genus. I have very little doubt of its being spinous, and if it is so, the species described by Dr. Dames will probably fall within its limits, and the genus Dorypyge be placed as a synonym of Olenoides. In the event of *Olenoides nevadensis* being generically distinct from *Dorypyge Richthofeni*,

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* Bull. U.S. Geol. Survey, 1886, No. 30, p. 183, t. 25, f. 2. The actual type of the genus is *O. nevadensis*, Meek, but of this the cephalic-shield is unknown.

† Richthofen's China, 1883, iv., p. 23.

‡ Bull. U.S. Geol. Survey, 1886, No. 30, p. 222.

§ Bull. U.S. Geol. Survey, 1886, No. 30, p. 222.

|| *Olenoides quadriceps*, H. and W., and *O. wahsatchensis* (=*Dikelocephalus? gothicus*, *H.* and W.)

Dames, then *Olenoides typicalis*, *O. Marcoui*, *O. spinosus*, *O. levis*, *O. flagricaudus*, *O. expansus*, *O. quadriceps*, and *O. wahsatchensis* may be referred to the genus Dorypyge." It will be observed that Mr. Walcott here suggests the possibility of *Olenoides quadriceps*, the presumed ally of our Heathcote fossils, being a *Dorypyge*.

*Protypus*, Walcott,* is another peculiar genus. One of its species, *Bathyurus senectus*, Billings,† resembles our fossils quite as much as does *Olenoides quadriceps*, although the type of the genus, *P. Hitchcocki*, Whitfield,‡ does not. In *P. senectus* we observe the same peculiar glabella, fixed cheeks, and small eye-lobes, but there is neither frontal groove, circumscribed lobes, nor ocular ridges. The pygidium of this species is unknown, but in the type of the genus it is small, and with an entire margin.

*Avalonia*, Walcott, with *A. manuelensis*§ as its type, although a Lower Cambrian form, may be referred to in passing from the similarity of its glabella to that of *Dinesus*, but three pairs of grooves are said to be present, and possibly a long narrow eye-lobe, as well as a peculiar narrow furrow on each fixed cheek between the axial grooves and the facial sutures, occupying the position of the ocular ridges.

Lastly, from *Protolenus*, Matthew,* the new genus differs much in the same way as from *Ptychoparia*, except that, as in the latter, the eye-lobes are short and small.

It may be that I have laid too much stress on the presence of the supplementary circumscribed lobes, but these, taken in conjunction with the form of the glabella and fixed cheeks, small ocular lobes, and the direction of the facial sutures, lead me to regard these Victorian Trilobites as generically distinct, not only from *Olenoides*, the genus suggested by Mr. Walcott, but also from any others I have been able to study through the works of reference at my command.

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* Bull. U.S. Geol. Survey, 1886, No. 30, p. 211.

† Bull. U.S. Geol. Survey, 1886, No. 30, p. 211, t. 31, f. 2, a-c.

‡ Bull. U.S. Geol. Survey, 1886, No. 30, p. 211, t. 31, f. 4.

§ 10th Ann. Report U.S. Geol. Survey, p. 646, t. 95, f. 3, 3a.

‖ Bull. Nat. Hist. Soc. N. Brunswick, 1892, No. 10, p. 34.

How far the presence of *Dinesus* alone will tend to prove the occurrence of a Cambrian area in Victoria, future research in the field must prove, but it lends colour to such a suggestion, and this is supported by the association of the Trilobites with a little Brachiopod of a decidedly Cambrian type. This will be referred to again.

Touching the other Trilobites of Cambrian age that have already been described from Australian rocks, the following remarks may be made:—No relation exists between *Dinesus* and *Protolenus Forresti*, Foord, from the Cambrian rocks of Kimberley, nor is it directly related to either of the species from the Parara Limestone of Yorke Peninsula, South Australia, viz.: *Ptychoparia australis*, Woodw., *Dolichometopus ? Tatei*, Woodw., *Olenellus ? Pritchardi*, Tate,* or *Microdiscus subsagittatus*, Tate.

The Tasmanian species from the Caroline Creek series are much more difficult of comparison from their poor state of preservation. Amongst them there seems to be a *Ptychoparia* or *Protolenus* (*P.? Stephensi*, Eth. fil.), and a possible *Dikelocephalus* (*D. ? tasmanicus*, Eth. fil.), with several other peculiar forms. Of the latter, little definitely can be said at present, for my paper† was founded on very poor and indefinite material, as evinced by the fact that I did not attempt to name the glabellæ (for such is their nature) in question. There is now, however, this amount of interest about them, that in all four the glabella is very much akin to that of *Dinesus*, but two possess well-marked furrows; a third has circumscribed basal lobes and no furrows, and may *possibly* be allied to Vogdes' *Lloydia;* whilst the fourth is furnished with neither lobes nor furrows of any kind. There for the present the comparison must rest.

The little Brachiopod referred to on a previous page consists of the specimen and its counterpart. It is quadrate in form, and measures only 7 mm. in length. It probably represents the two valves crushed together, with a nearly horizontal hinge line, and showing through the substance of the shell a strong septum, probably that of the dorsal valve. It is covered with very delicate concentric lines, representing the original sculpture of

* This Trilobite seems to me hardly separable from *Dolichometopus Tatei*, Woodw.

† Papers and Proc. Roy. Soc. Tas. for 1882 [1883], p. 156, t. 1, f. 8–11.

the surface. A tentative opinion, however, can only be passed as to the identity of this little fossil; but on passing in review the lower forms of Brachiopod life, one is struck with the resemblance, in a general sense, with two genera described by Dr. Waagen from the Cambrian series of the Salt Range, India, viz.—*Neobolus** of the family Obolidæ, and *Lakhmina*, Oehlert;† a member of the Trimerellidæ. No trace of internal structure being preserved in our fossil beyond a septum, as previously stated, it is impossible to decide satisfactorily to which of the two it is most nearly allied. Viewed exteriorly, the resemblance to *Lakhmina linguloides*, Waagen,‡ is very strong, particularly in the form and sculpture. It is, therefore, quite possible that it may be referable to this curious genus. At any rate, it is a form entirely new to Australian Palæontology, and I am much indebted to my assistant, Mr. W. S. Dun, for the trouble he has taken in unravelling its possible affinity.

The drawings have been executed with care and exactitude by Mr. Edgar R. Waite, to whom I also beg to express my thanks.

## DESCRIPTION OF PLATE.

*Dinesus ida* (Eth. fil.).

Fig. 1.—Glabella and fixed cheeks, with circumscribed lobes, frontal border, neck-ring, and ocular ridge on the left fixed cheek.

Fig. 2.—A smaller but similar specimen.

Fig. 3.—Glabella and fixed cheeks, with the anterior circumscribed lobes, and the left ocular lobe.

Fig. 4.—Specimen similar to Fig. 1, somewhat obliquely pressed, showing distinctly the left eye lobe and ocular ridge.

Fig. 5.—Pygidium of five coalesced segments, but wanting the posterior apical margin. The limb is produced into five spines.

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* Pal. Indica (Salt Range Fossils), 1885, I., Pt. 4, fas. 5, p. 756.

† Waagen, *loc. cit.*, 1889, iv., Pt. I., p. 81; 1891, iv., Pt. 2, t. 2, f. (= *Davidsonella*, Waagen, non M. Chalmas, *ibid*, 1885, I., Pt. IV., fas. 5, p. 761.

‡ *Loc. cit.* 1891, iv., Pt. II., t. 2, f. 3 and 4 ( = *Davidsonella linguloides*, Waagen, *ibid*, 1885, I., Pt. IV., fas. 5, p. 764, t. 85, f. 3-6.

Fig. 6.—A smaller and somewhat more triangular tail, also of five segments, but with six lateral spines.

Fig. 7.—Pustular ornamentation of the glabella and fixed cheeks.

*Lakhmina ?* sp.

Fig. 8.—One or two (?) compressed valves showing a strong septum through the test, also a fine concentric line sculpture.

Figs. 1, 6, and 7 are magnified twice.

Fig. 8 highly magnified.

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ART. V.—*Note on the Customs connected with the use of the so-called Kūrdaitcha Shoes of Central Australia.*

BY P. M. BYRNE.

(Communicated by PROFESSOR SPENCER).

[Read November 14th, 1895.]

The following notes were written in 1892 in response to the request of a correspondent, and are the result of careful inquiries conducted amongst the blacks in the Charlotte Waters district. As they have been gathered at first hand and are somewhat more detailed than any yet published, it has been suggested to me that it would be worth while placing them on record.

I have been for many years well acquainted with the natives of this district, but owing to the fact that it is now more than twenty years since the custom was practised, considerable care has to be taken in order to secure authentic information. Any blackfellow will give the inquirer replies to his questions, but it is only after making a great number of inquiries and obtaining corroboration from various sources that it is possible to arrive at a conclusion as to what is and what is not reliable information.

There are in this district only two old men who have ever worn the shoes themselves; the younger men only know of the custom from the elders of the tribe, and in a few years it will probably be forgotten. The shoes are now only made to supply the orders of the whites, or perhaps to enable the old men to illustrate the deeds of other days before the half-admiring, half-sceptical members of the younger generation.

The shoes themselves have been previously described. They consist of a sole made of human hair and a great number of intertwined emu feathers, a certain amount of human blood being used as a kind of cementing material. The whole form a large pad, flat above and convex below, with the two ends rounded off so that there is no distinction between them. The upper part is in the form of a net, made of human hair, with a central opening for the foot, across which stretches a cord of hair which serves as a strap for the instep.

The shoes themselves in this district are known by the name of "Urtathurta," and the occasion on which they were used is spoken of as "Kūrdaitcha lūma" (Kūrdaitcha—a bad or evil spirit, and lūma, to walk).

The wearing of the Urtathurta and going Kūrdaitcha lūma appears to have been the medium for a form of vendetta, though it was quite distinct from the "Adninga" or war party which was always despatched to avenge the death of a native supposed to have been killed by spells or to recover a lubra who had been stolen.

When any native threatened the life of a member of a different tribe, the threatened man could await his enemy's attack or take the initiative himself. If he decided upon the latter course the medicine man was consulted and a "Kūrdaitcha lūma" arranged. In either case the attacking native was called Kūrdaitcha. A medicine man always accompanied the latter, and both were similarly attired.

The head-dress worn consisted of a bunch of feathers in front and a bundle of green leaves behind. As a disguise the face was blackened with charcoal, the whiskers tied back behind the neck, and a broad white stripe of powdered gypsum was drawn from the top of the forehead down the nose to the bottom of the chin, while a similar stripe extended across the chest from shoulder to shoulder.

A girdle made from the hair cut from the head of a blackfellow after death was worn round the waist. This special form of hair girdle is supposed to serve the double purpose of increasing the strength of the wearer, his courage, and the accuracy of his aim —it embodied, in fact, all the warlike attributes of the dead warrior—and at the same time it produced inaccuracy of aim in the enemy.

Ordinary hair-string was worn round the legs for the purpose, as the blacks say, of protecting them against snake-bite.

Both medicine man and Kūrdaitcha carried a sacred stone, the possession of which is supposed to be even more efficacious than that of the hair girdle.

In addition, the medicine man carried in his girdle a live lizard.

On leaving his camp the Kūrdaitcha walked in front, followed at a short distance by the medicine man, both armed with spears,

and carrying the Urtathurta, or shoes. When hidden from view of the camp they put on the shoes, and proceeded towards the enemy's camp. The Kūrdaitcha always led the way, and every precaution was taken to prevent their advance being seen. On arriving at the camp the Kūrdaitcha crept forward alone, holding the sacred stone between his teeth, and (if successful) speared his enemy dead. The medicine man then came up and inserted the head of the lizard which he carried into the wound. The lizard was supposed to drink up the blood, and so to remove evidence of the manner in which the deed had been done. Sometimes the wound was seared to prevent its being recognised as a spear wound. Almost invariably the attack was made at night and, when successful, the Kūrdaitcha and medicine man started back at once, halting some distance from their camp to remove and conceal the shoes before going in. If by chance the tracks of the Kūrdaitcha were seen they were avoided, and the threatened camp merely kept on the alert. If the Kūrdaitcha himself were seen in the vicinity of the camp he was at once attacked and, if possible, killed. The medicine man who accompanied him was, in all cases, allowed to return uninjured to his camp.

When the body of a man murdered by a Kūrdaitcha was discovered no attempt was made to track the latter, but the medicine man immediately appointed a relative of the murdered man or, failing a relative, one of the same group (a Kūmarra if he were a Kūmarra or a Panunga if he were a Panunga, etc.) to avenge him. This was done by going as a Kūrdaitcha in the way described. If the Kūrdaitcha were unable to find the particular man he wanted he would spear a man belonging to the same tribe, but this seems to have been of rare occurrence.

Immediately a Kūrdaitcha was seen near a camp the man who detected him informed the others of the fact by saying, "Udnurrah pitchimi" (Udnurrah, a wild dog; pitchimi, is coming). He did not mention the word Kūrdaitcha, but his meaning was understood and preparations were made for an attack on the Udnurrah. In this connection one of the head men of the tribe informed me that, when a blackfellow reported "Udnurrah pitchimi" the medicine man could appoint a Kūrdaitcha who had the power of accosting the other Kūrdaitcha and of compelling him to return to his camp, but I have been

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unable to fully corroborate this, though it seems possible that, when the custom prevailed to an abnormal extent, such a course was adopted to prevent excessive bloodshed.

It is usually stated that the object of the curious shape of the shoes was to prevent the tracks of the Kūrdaitcha from being recognised. This may have been the case to a certain extent, but at the same time it must be remembered that in certain respects the blacks have a very powerful imagination, and their idea of not being able to track a Kūrdaitcha is very possibly an example of this. There is practically little doubt but that if a blackfellow really tried to track a Kūrdaitcha he would do so well enough—a stick or a stone turned out of the way or the nature of the impress of the rounded sole in sand would be quite sufficient clue to an expert tracker, such as these natives are, to show him the direction in which the Kūrdaitcha had passed. Most probably it is, one might call it, an article of faith that a Kūrdaitcha cannot be tracked. There is something mysterious about him—he wears the sacred stone and hair girdle which are supposed to give him special powers; the carrying of a sacred stone when fighting is even supposed to make a man invisible to his enemies, and he commits the deed under the cover of darkness.

It would probably be more correct to say, not that the wearing of the shoes makes it impossible to track the Kūrdaitcha, but that the blacks make themselves believe that it does so.

Art. VI.—*Notes on Didymograptus caduceus, Salter, with Remarks on its Synonymy.*

By T. S. Hall, M.A.

Demonstrator and Assistant Lecturer in Biology in the University of Melbourne.

[Read November 14th, 1895.]

This species is very well known to Australian geologists, its occurrence in Victoria having been announced by Professor Sir Frederick McCoy in 1861,* and in 1875 he figured it in his Prodromus of the Palæontology of Victoria,† giving at the same time a very full and careful description, and enumerating several of the variations under which it presents itself.

While it is fairly constant in form, it shows a great range of variability in several points, such as the width of the stipe, the number of hydrothecæ in a given length, and the size of the sicula. In one point I have, however, not been able to confirm the exactness of the figures in the Prodromus, though, as will be presently seen, I do not deny the possibility of the occurrence of specimens exhibiting this feature.

The examination of a large series has shown that the first two hydrothecæ formed are in contact by their inferior margins for from about a quarter to three-quarters of their length, leaving between the outer extremities of these margins a more or less deep, acute, V-shaped space, the apex of which is rounded, probably by an extension of the periderm between the two hydrothecæ. In one example from Castlemaine the margins only of the hydrothecæ are preserved in this region, being shown as a fine black line. In this specimen the concrescence of the margins of the first two hydrothecæ is clearly seen for a portion of their length; they then diverge, leaving between them a space which is acutely pointed below, no extension of the periderm being seen. From its position, immediately over the broad extremity

* Exhibition Essays, 1861, p. 161, reprinted in A.M.N.H., vol. ix., 1862.

† Decade II., plate xx., figs. 3, 4, 5.

of the sicula, it is improbable that the slight extension of the periderm represents a median azygos hydrotheca, and from the fact that it is clearly seen to be closed below in some specimens it cannot represent the upper open end of the sicula. The figures in the Prodromus, above alluded to, apparently show the first two hydrothecæ in contact by their inferior margins throughout their whole length, and since they are certainly in contact in most specimens for a part of their length, there is nothing inherently improbable in this occurrence; still, I have not seen an instance of it. Sir Frederick McCoy has kindly allowed me to examine closely the examples of this species in the National Museum, including the two larger specimens figured in the Prodromus. The specimen from which figures 5 and 5*a* were taken could not, however, be identified. The two larger specimens figured are not sufficiently well preserved to allow of an expression of opinion one way or the other. All the well-preserved specimens in the Museum showed the character I have drawn attention to. Nearly 150 specimens in my own collection and ninety-six in the collection of Mr. G. B. Pritchard (which were kindly placed at my disposal by him) showed the same structure. Mr. J. A. Atkinson has obligingly examined about fifty examples which he has from Castlemaine, and has shown me four in which the separation of the distal ends of the margins is not clear; but as the examples are not very well preserved, and are, I think, slightly distorted, they cannot be taken into account. Thus in fully 300 examples which were in a fairly good state of preservation the character is constant, and the only specimens in which it was not clearly shown were either damaged, weathered, or distorted by cleavage.

Dr. Perner has recently figured two examples from Bohemia,* which are, however, so imperfectly preserved and distorted in the sicular region that the original form of this portion is quite indecipherable.

## Synonymy.

Considerable confusion exists as to the generic position and correct name of this species. *Didymograptus caduceus* was

* Etudes sur les Graptolites de Bohême, 2ième partie, pl. vi., figs. 9, 10, 11.

originally founded by Salter on some specimens from Canada submitted to him by Dr. Bigsby,* and was subsequently recognised by its describer in the Skiddaw slates of England.† James Hall‡ referred Salter's species to a form which he named *Graptolithus bigsbyi* (a Tetragraptus), and which appears to be regarded by some authors as a synonym of *T. bryonoides* (*T. serra*).

If the reference were correct, then Salter's name should stand and not Hall's, a fact already pointed out by Herrmann.§ However, the identity is by no means clear. Salter's figures plainly show a form in which the width of the stipe immediately over the sicula is as great as that of its more distal portion; while from the minor end of the sicula the prolongation of the virgula, so characteristic of the species, is represented as a fine, hair-like line; moreover, he begins his description with the words "D. stipite filiformi longo." In Hall's figures, on the other hand, the median process is clearly a third branch, and in no way resembles the delicate thread shown by Salter, and which in our specimens is certainly not a branch.

Professor H. A. Nicholson, in his paper on the Skiddaw graptolites,‖ states that from an examination of *Tetragraptus bryonoides* he is inclined to agree with James Hall, and refer all the specimens in the *caduceus* form which he has seen to that species. At the same time he says that "whilst it is possible that there may really exist a distinct species with the characters of *D. caduceus*, Salter, it certainly appears not to occur in the Skiddaw slates, since all the specimens which could be referred to this species, when well preserved, show traces of a third and even sometimes of a fourth stipe." At a subsequent date¶ he found a species in the Skiddaw slates which seems to agree perfectly with Salter's Canadian species. This species he named *D. gibberulus*. As a justification of his position he says that

* Quart. Journal Geol. Society, ix., p. 87.

† *id.*, xix., p. 136.

‡ Graptolites of the Quebec group, pp. 42, 87.

§ See Geological Magazine for 1886.

According to Perner (Etudes sur les Grap. de Bohême, pt. ii., p. 20) the reference to the species as *Tetragraptus caduceus* is due to Brögger, but the paper by the latter author is inaccessible to me, and as Perner's paper only arrived in Melbourne the day before this article was appointed to be read, I have left the reference as it stands.

‖ Quart. Jour. Geol. Soc., vol. xxiv., pp. 131-133.

¶ Annals and Mag. Nat. Hist. 4, xvi., 271.

Salter's *original* specimen was beyond doubt an example of *Tetragraptus bryonoides* or *T. bigsbyi*, and that Salter then confused an English species with it. It seems to me, however, that Professor Hall has by no means proved that Salter made a mistake, for he apparently did not see Salter's species—at any rate, he does not figure it. The Skiddaw slates and the Quebec group are on the same horizon, so there is nothing improbable in Salter's species being found in England. From this it would appear that *D. gibberulus* must be relegated to synonymy, for it does not seem separable from *D. caduceus*.

Mr. R. Etheridge, jun., in his paper on the Victorian graptolites,* when dealing with *T. bryonoides*, accepts the decision that *D. caduceus* is referable to that species. At the same time he suggests the advisability of keeping Salter's name for a variety which he recognises as constant in its characters, and as agreeing with Salter's figures and descriptions.

In a previous paper† I tacitly accepted the identity of *Tetragraptus bigsbyi* and *Didymograptus caduceus*, and, as Salter had clear priority, called the species *T. caduceus*, in this following Herrmann's lead. At the same time I kept *T. bryonoides*, Hall, (= *T. serra*, Brong.) distinct. I now regard Salter's species as a clear *Didymograptus*. I examined a very large number, probably some thousands, in the field during my residence in Castlemaine, where it occurs in profusion, and gathered every specimen that appeared to point to its being a *Tetragraptus*. These I have repeatedly examined carefully and without any hesitation refer all the forms with more than two arms to *T. serra*, Brong. The distinguishing points are just those that Professor Nicholson drew attention to when describing *D. gibberulus*. The distinction is that the first developed hydrothecæ of *D. caduceus* are as large as any subsequently formed, and that their long axis agrees with that of the sicula; whereas in *T. serra* (= *T. bryonoides*) they are invariably much smaller and diverge greatly from the sicular axis usual in Didymograpti. The result of this is that the stipe of the latter species is much contracted or narrowed in the sicular region, while in the former species it practically reaches its full width at once.

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* Annals and Mag. Nat. Hist., 4. iv. † Proceedings Royal Soc. Victoria, 1894.

The Synonymy may then be expressed as follows :—

*Didymograptus caduceus*, Salter.

*Didymograptus caduceus*, Salter, Q.J.G.S., ix., 87, fig. 1, *id.* xix., p. 136, figs. 13*a*, *b ;* McCoy, Prodromus of the Palæontology of Victoria, Decade ii., pl. 20.

*Graptolithus bigsbyi*, pars. J. Hall, Grap. Quebec Group, pp. 42, 87.

*Tetragraptus bryonoides*, pars. Nicholson, Q.J.G.S., xxiv., pp. 131, 133; R. Etheridge, junior, Ann. and Mag. Nat. Hist., 4, iv., pl. iii., figs. 3, 4.

*Didymograptus gibberulus*, Nicholson, A.M.N.H., 4, xvi., p. 257.

*Tetragraptus caduceus*, Herrmann, Nyt. Mag. for Naturvid, xxix., translated in Geol. Mag., 1886 ; ? Brögger, Die Silurischen Etagen im Christianiagebiet.

# Art. VII.—*A Revision of the Fossil Fauna of the Table Cape Beds, Tasmania, with Descriptions of the New Species.*

(Plates II., III., IV.).

By G. B. Pritchard,

Lecturer in Geology, Working Men's College, Melbourne.

[Read 10th October, 1895.]

The present paper is the outcome of the study of the very fine collection of fossils from the Table Cape beds made by Mr. E. D. Atkinson. The collection was some short time ago left in the charge of Mr. C. French, Government Entomologist, through whose kindness and influence the request of Professor Spencer that the collection should be deposited on loan in the Biological Museum at the Melbourne University, to be named and worked out, was at once complied with. I have to thank these gentlemen for allowing me the privilege of attempting the work. The collection is made up as follows:—Gastropoda, ninety-two species; Lamellibranchiata, thirty-nine species; Brachiopoda, seven species; Echinodermata, three species; Corals, three species; making a total of 144 species, including among the mollusca twenty new species and two new varieties, which are herein described.

I have given full references to each described species and remarks on the species where deemed necessary, and wherever I have departed from the usual identifications I have given my reasons in full for so doing.

During the study of the above I thought it well to find out what further material might be obtained from the collection from this locality presented by Mr. Gronow to the Ballarat School of Mines Museum, accordingly I obtained from Mr. Alex. Purdie, the present curator, a list of their fossils, which number fifty-one species, the more important of which, for my present purpose, were very kindly forwarded to me for examination. I tender Mr. Purdie my best thanks for his ready response.

Upon asking the former curator, Mr. F. M. Krausé, who was responsible for the naming of the Ballarat collection, he informed me that it was examined and named by himself.

There appear, however, to be only three additional species to those in the Atkinson collection, and these I have referred to in what follows.

Having gone so far, I have thought it well to add as an appendix as complete a list as possible of the records from these beds. This appended list includes 114 species, and in the classes I have not touched in this paper Mr. R. M. Johnston records twenty-three species. We have thus the grand total of 281 species referable to this horizon. The complete summary being—

| | |
|---|---|
| Mammalia | 1 |
| Pisces | 3 |
| Cephalopoda | 1 |
| Gastropoda | 153 |
| Lamellibranchiata | 65 |
| Brachiopoda | 17 |
| Polyzoa | 9 |
| Echinodermata | 3 |
| Zoantharia | 19 |
| Foraminifera | 10 |
| | 281 |

From this it can be seen that we have 219 species of mollusca proper, and included amongst these there are seven living species. As, however, two of the latter, namely, *Limopsis aurita* and *Chamostrea albida*, are exceedingly doubtful records, it is, I think, reasonable to leave them out of consideration for the present. Taking into account, then, the remaining five, the percentage of living species for these beds is just about a fourth over two per cent.

When it is taken into consideration that as many as twenty different living molluscan species have been recorded as occurring in these beds, and that subsequent examination of the shells has brought this list down to the above, we are not surprised at the confusion that has existed as to the age of the beds.

For the geological features of the Table Cape beds we are indebted to Mr. R. M. Johnston, who has given full details in his papers contributed to the Royal Society of Tasmania, yet when writing these papers he was in no wise certain as to the correct age to which they should be assigned.

In 1876* Mr. Johnston was of the opinion that sufficient was not then known of either the living or extinct forms, and on that account any attempt at classification would be premature and misleading.

In 1879† Mr. Johnston states :—"Of the testacea only about five per cent. are known to exist. This continual lessening of the percentage of living to extinct forms as our knowledge increases is most significant. According to the principle which has been adopted by Mr. Lyell, and through him by nearly all the English geologists, this low percentage of living representatives indicates rather more an eocene than a miocene age for our marine beds at Table Cape."

In 1884‡ the same author remarks :—" If we are not prepared to reject the *percentage* method in the determination of the great divisions of the tertiary period, we must assuredly refer the Table Cape beds not to the *miocene*, but to the *eocene* or "early dawn" of the tertiary period in Australia. Also: "The investigations carried on by Professor Tate and other indefatigable workers since that time [1879] have placed this matter beyond all reasonable doubt, and now there is every reason to believe that the Table Cape beds, with their Australian equivalents, mark the earliest dawn of the eocene period in Australia."

Yet following this, in 1887,§ and again in 1888,‖ Mr. Johnston seems to have had some misgivings, as he apparently could not then see his way clear to adopt any more definite classification for the Tasmanian tertiaries than that indicated by the introduction of such terms as palæogene and neogene.

From the percentage of living species herein stated it can, I think, be seen that we cannot do otherwise than regard these beds as of eocene age. I am also of the opinion that further investigation of the fauna of these beds will tend rather to lower

* Proc. Roy. Soc. Tas., 1876, p. 89.

† *Op. cit.*, 1879, pp. 86, 87.

‡ *Op. cit.* 1884, p. 224.

§ *Op. cit.*, 1887, p. 135 *et seq.*

‖ Geology of Tasmania, p. 208 *et seq.*

than raise the percentage of living forms, for it is a very noticeable and important fact that in the collection at present under examination, although it consists almost wholly of large species, there are upwards of twenty new forms included in less than 150 species. When the small shells are more thoroughly known, the list of species ought to be very materially increased; and judging from the fauna of similar beds in Victoria, the recent species are not likely to be largely increased, if at all.

Mr. Johnston's section* of the Table Cape beds is as follows:—Cap of recent basaltic tuff and wacke, 80 feet; calcareous sandstone and frequent bands, containing abundant remains of corals, echinoderms, and brachiopods, 78 feet; Crassatella bed, 80 feet, which apparently indicates a thickness of 158 feet for the marine beds; yet subsequently† the same author states that "nowhere along the Tasmanian coast does the marine group exceed 70 feet in thickness." I fail to comprehend what this means. The present collection of fossils came principally from the lower deposits locally known as the Crassatella bed, and judging from the fossils I regard this zone as the direct equivalent of the so-called middle beds of the Spring Creek section in Victoria. The coarseness of the material in which a number of the Table Cape fossils is preserved, the worn character of many of the species, and the abundance of fragments of shells, clearly indicate the littoral character of the deposit, and as an attendant fact of some importance we have certain faunal characteristics indicative of the same feature. On the other hand the clayey portions at least of this zone at Spring Creek do not appear to have been quite so close to land, as evidenced by the finer sediments, and the absence hitherto of any specially littoral fossil forms. The comparatively slight differences existing between these two representatives of what I regard as the same zone appear to me to be adequately accounted for by the fact that the one set of deposits was laid down very much closer to the then existing shore line than the other.

Another representative of this horizon in Victoria appears to be the clay beds of Cape Otway, as evidenced by the fossils

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* Proc. Roy. Soc. Tas., 1876, section opposite p. 90.

† Geology of Tasmania, pp. 244, 245.

recently recorded by Messrs. Tate and Dennant.* The upper calcareous sandy beds at Table Cape most probably belong to the same horizon as the Crassatella beds, merely showing a certain amount of lithological variation, a feature which is also well displayed in this zone at Spring Creek.

The types of the species described in this paper, unless otherwise stated, are at present deposited on loan in the Biological Museum of the University of Melbourne.

## LIST OF ABBREVIATIONS.

P.R.S.Tas. = Proceedings of the Royal Society of Tasmania.

P.R.S.N.S.W. = Proceedings of the Royal Society of New South Wales.

Trans. Phil. Soc., S.A. = Transactions of the Philosophical Society of Adelaide.

T.R.S.S.A. = Transactions of the Royal Society of South Australia.

Trans. N.Z. Inst. = Transactions of the New Zealand Institute.

A.M.N.H. = Annals and Magazine of Natural History.

Prod. Pal. Vic. = McCoy's Prodromus of the Palæontology of Victoria.

Geo. Tas. = Geology of Tasmania, 1888, by R. M. Johnston.

Q.J.G.S. = Quarterly Journal of the Geological Society of London.

Akad. d. Wiss. = K.K. Akademie der Wissenschaften, Wien.

Cat. Aust. Foss. = Catalogue of Australian Fossils, by R. Etheridge, jun.

Gast. I. = Transactions of the Royal Society of South Australia, vol. x., 1888. Gastropoda of the Older Tertiary of Australia, part i., by Professor Ralph Tate.

Gast. II. = *Op. cit.*, vol. xi., 1889, Gastropoda, part ii.

Gast. III. = *Op. cit.*, vol. xiii., part ii., 1890, Gastropoda, part iii. Plates deferred to vol. xv., part i., 1892.

Gast. IV. = *Op. cit.*, vol. xvii., part ii., 1893, Gastropoda, part iii.

Lam. I. = *Op. cit.*, vol. viii., 1886, Lamellibranchs, part i.

Lam. II. = *Op. cit.*, vol. ix., 1887, Lamellibranchs, part ii.

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* Trans. Roy. Soc. S.A., 1895, vol. xix., pt. i., p. 3 *et seq.*

TABLE CAPE FOSSILS.

## GASTROPODA.

### 1. **Murex (Pteronotus) calvus**, Tate.

*Id.*, Tate, Gast. I., 1888, p. 96, pl. i., fig. 11.

### 2. **Murex (Phyllonotus) eyrei**, T. Woods.

*M. eyrei*, T. Woods, P.R.S. Tas., 1876, p. 93.

*M.* (*Phyllonotus*) *eyrei*, Tate, Gast. I., 1888, p. 103, pl. iv., fig. 8.

*M. eyrei*, Johnston, Geo. Tas., 1888, p. 237.

*Observations.*—The shell figured by Mr. R. M. Johnston in his Geology of Tasmania, plate xxxi., figs. 3 and 3*a*, and referred to in the explanation of the plate as *M. eyrei*, T. Woods, is not that species, but may probably represent *Rapana aculeata*, Tate, which also occurs in the Table Cape beds.

### 3. **Murex minutus**, Johnston.

*Id.*, Johnston, P.R.S. Tas., 1879, p. 32.

*Id.*, Tate, Gast I., 1888, p. 107, pl. x., fig. 14.

*Id.*, Johnston, Geo. Tas., 1888, p. 237, pl. xxix., fig. 7.

### 4. **Typhis maccoyii**, T. Woods.

*T. maccoyii*, T. Woods, P.R.S.Tas., 1875, p. 22, pl. i., fig. 5.

*T. hebetatus*, Hutton, Trans. N.Z. Inst., vol. ix., 1877, pl. xvi., fig. 1.

*T. maccoyii*, Tate, Gast. I., 1888, pp. 91, 92.

*T. maccoyii*, Johnston, Geo. Tas., 1888, p. 237, pl. xxix., fig. 11.

### 5. **Rapana aculeata**, Tate.

*R. aculeata*, Tate, Gast. I., p. 113, pl. ii., fig. 8.

*Murex eyrei*, R. M. Johnston (*non* T. Woods), Geo. Tas., pl. xxxi, figs. 3, 3*a*.,

### 6. **Trophon selwyni**, sp. nov. Plate II., fig. 7.

Shell small, rather thin, sometimes very thin and fragile, with an elevated and prominent acute spire of strongly convex and

costated whorls, ending in a full ventricose body-whorl with a comparatively large aperture, and with a very short twisted canal.

Apical angle about fifty to fifty-five degrees. Apex consists of about two smooth, well-defined convex embryonic whorls, with a centrally immersed tip. Embryonic whorls succeeded by five gradually increasing, markedly convex whorls, with a well-defined and somewhat impressed suture, occasional specimens being more constricted at the suture than the usual type. The greatest convexity about the middle of each whorl, with a tendency to shouldering at about the posterior third, as a consequence of the slope of the posterior third of each whorl being somewhat more sudden and flatter than the more regularly convexly rounded anterior two-thirds. Spire-whorls terminate in a broad ventricose body-whorl, with a rather large oval aperture.

Outer lip thin and sharp at the outer edge, slightly thicker internally, and bearing about twenty to twenty-two close, narrow, and short ridges in its full length from its junction with the anterior canal to the posterior suture. Inner lip very thin and concavely arched to the columella, the latter being rather strongly twisted. Canal very short, strongly bent to the left, finally somewhat reverted, and at the same time upwardly raised.

Surface ornamented with transverse costæ crossed by relatively coarse and fine spiral threads. The earlier half of the first spire-whorl is finely and very closely costate, bearing about five or six fine costæ. Subsequently the costæ become relatively broader and much wider apart. The ordinary costæ are narrow, with much broader interspaces between them, fade out before reaching the posterior suture, and usually developed right up to the anterior suture. In number they run from about nine to eleven to a whorl, and in some specimens show a tendency to become obsolete on the body-whorl. The costæ and interspaces are traversed by lines of growth and fine close striæ parallel to them. The transverse striæ are occasionally more noticeable on the posterior whorls, where they are sometimes sufficiently strong to give rise to a fine cancellated ornament by being crossed by the spiral threads. The whole of this transverse ornament is crossed by spiral threads, from five to seven of which are stouter than the remainder; and of these, three or four on the anterior slope of

each whorl are the stoutest and most prominent where they cross the costæ. Between the coarser threads is intercalated a finer thread which has a still finer thread on either side of it, more easily seen on the body and penultimate whorls than on the earlier spire whorls.

*Dimensions.*—Length, 16 mm.; breadth, 10 mm.; length of aperture, 6 mm.; breadth of aperture, 4 mm.; length of canal, 3 mm. Some of the Table Cape specimens are relatively smaller than given above, one of these examples giving the following dimensions:—length, 12 mm.; breadth, 7 mm.

*Locality.*—Not uncommon in the lower beds of the lower eocene of Spring Creek, near Geelong, Victoria. Also in the eocene beds of Table Cape, Tasmania, three examples.

*Observations.*—I am not at present wholly satisfied with the generic position of this species, but merely place it here tentatively whilst awaiting further examination of other material. The faint development in some specimens of what I cannot but regard as a tendency towards varices, taken together with the other characters displayed by the shell, seem certainly to indicate that it should be placed in the Muricidæ. It may at once be separated from any of our previously described tertiary species referred to this genus by its very short canal, its prominent spire, ventricose whorls, and the constricted suture. So far as the present specimens go, the Table Cape representatives seem to be hardly so ventricose in the body-whorl as those from Spring Creek, the difference in aspect being no doubt due to the fact that the costæ have become obsolete. In other respects the shells are in my opinion sufficiently close to be regarded as identical.

Species' name in honour of Sir A. R. C. Selwyn, late Director of the Geological Survey of Canada, and formerly Director of the Geological Survey of Victoria, to whom we are indebted for much of the best geological work done in this colony. Type specimen in my own collection.

### 7. Triton abbotti, T. Woods.

*T. abbotti*, T. Woods, P.R.S.Tas., 1874, p. 24, pl. i., fig. 8.

*T. abbotti*, Tate, Gast. I., 1888, p. 117.

*Tritonium abbotti*, Johnston, Geo. Tas., 1888, p. 237, pl. xxix., fig. 13.

### 8. Triton tortirostris, Tate.

*T. minimum*, T. Woods (non Hutton), P.R.S.Tas., 1876, p. 107.
*T. tortirostris*, Tate, Gast. I., 1888, p. 123, pl. v., fig. 7.
*Tritonium minimum*, Johnston, Geo. Tas., 1888, p. 237.

### 9. Fusus acanthostephes, Tate.

*F. acanthostephes*, Tate, Gast. I., 1888, p. 133, pl. vii., fig. 7.
*F. spiniferus*, Tate, *op. cit.*, p. 134, pl. vii., fig. 1.

*Observations.*—I have no hesitation whatever in regarding *F. spiniferus*, Tate, as a synonym of the above in view of my examination of a large series of specimens. Among the principal differences upon which Professor Tate has apparently relied for the specific distinction of *F. spiniferus* are the shorter spire, the variable apex, and the difference of ornament, particularly the absence of spiral ornament on the posterior slope of the whorls. The Table Cape specimens are a particularly interesting series, as some are ornamented in an exactly similar manner to *F. spiniferus* from the River Murray Cliffs, as proved by the comparison of actual specimens; but their spire is as long as that in the ordinary type of *F. acanthostephes*, and the embryonic whorls are also identical with those in the latter species. Other specimens approach *F. acanthostephes* in ornament and are important connecting links. A further examination of a large number of specimens from Muddy Creek and Mornington clearly and amply confirms the above conclusion, and it is at once seen that *F. acanthostephes* varies in the length of its spire, the fulness and size, and on that account appearance of the embryonic whorls, and in its ornament, to such an extent that *F. spiniferus* cannot possibly be regarded as specifically distinct.

### 10. Fusus meredithæ, T. Woods.

*F. gracillimus*, T. Woods (non Adams and Reeve), P.R.S. Tas., 1875, p. 22.
*F. meredithiæ*, T. Woods, *op. cit.* Explanation to pl. i., fig. 6.
*F. meredithæ*, Tate, Gast. I., 1888, p. 140.
*F. meredithæ*, Johnston, Geo. Tas., 1888, p. 237, pl. xxxi., fig. 9.

11. **Fusus johnstoni**, T. Woods.

*F. johnstoni*, T. Woods, P.R.S.Tas., 1876, p. 94.
*F. johnstoni*, Tate, Gast. I., 1888, p. 136, pl. xii., fig. 4*a*, 4*b*.
*F. johnstoni*, Johnston, Geo. Tas., 1888, p. 237, pl. xxix., fig. 9, and pl. xxxi., figs. 7, 8, 10 and 17.

12. **Latirofusus cingulata**, sp. nov. Plate II., figs. 5 and 6.

Shell elongate and narrowly fusiform, consisting of an obtuse embryonic portion of about two-and-a-half smooth convex whorls, the apex of which is central, succeeded by from six to eight gradually increasing very slightly convex whorls.

Apical angle from about twenty to twenty-five degrees. The smooth embryonic portion makes the apex of the shell obtuse, as its whorls are shorter, more convex, and slightly wider than the succeeding spire-whorl. Suture most distinct between the earlier or posterior spire-whorls, becoming less marked anteriorly; the convexity of the whorls also slightly stronger posteriorly, with a tendency to become flatter anteriorly, greatest convexity in the anterior half of each whorl. Aperture oval, peristome much thickened at the suture in adult specimens, outer lip with a thin, sharp and crenulated outer edge, thickened and ridged internally, about six well-defined widely separated internal ridges. Posterior of the aperture slightly channelled, anterior prolonged into a long narrow canal, which is a little more than one-third the length of the shell. Columella long and straight, and furnished at the anterior end of the aperture, just above the canal, with one strong oblique plait.

Surface ornamented with spiral threads crossed transversely by costæ, striæ, and lines of growth. Of the spiral threads there are four or sometimes five, which are strong, well-raised, and convexly rounded, with a much finer intercalated thread between, the latter, almost in some specimens and wholly in others, filling the intermediate space between the stronger spiral threads. The transverse ornament crossing the spiral consists, first, of close, regular, convexly-rounded costæ, about eight in number on the earlier or posterior whorls, increasing anteriorly to about fourteen on the body-whorl. The costæ are strongest about the middle of each whorl, and fade away towards the posterior and anterior

sutures. They are also stronger on the posterior whorls, becoming less distinctly defined anteriorly. Secondly, there are the lines of growth and the fine parallel striæ transverse to the spiral ornament.

*Dimensions.*—The Table Cape specimens are unfortunately imperfect examples, but the measurements which have been made are as follows: Length (apex and end of canal wanting), 22 mm.; breadth, 7 mm.; length of aperture, 4 mm.; breadth of aperture, 2·5 mm; length of canal (incomplete), 7 mm.

I happen to be fortunate enough to have some perfect though smaller and apparently younger examples of what I regard as the same species from the Spring Creek beds, near Geelong, and on account of their better state of preservation I make one of these specimens the type of the species, the following being its dimensions:—Length, 17 mm.; breadth, 4 mm.; length of aperture, 3 mm.; breadth of aperture, 1·5 mm.; length of canal, 7·5 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania. Two examples. Also not uncommon in the lower beds of the lower eocene series of Spring Creek, near Geelong, Victoria.

*Observations.*—Up to the present time there has been only one described fossil species referred to this genus from the Australian tertiary deposits, and this has hitherto been obtained rather commonly from the eocene beds of Muddy Creek, Mornington, and from beds of equivalent horizon at several other Victorian localities. This form was originally described by Professor Tate under the name of *Fusus aciformis*, but was recently altered by him to *Latirofusus aciformis.** The present described species may be readily distinguished from *L. aciformis* by its smaller embryonic whorls, by the greater convexity of the spire-whorls, and by its very distinct ornament, having a few strong spiral threads with finer intercalated ones, and a distinct transverse costation, instead of the fine, cancellated ornament of *L. aciformis*. From the Parisian eocene fossils, and also from the living species referred to this genus, the present eocene form is, as far as I have been able to make out, specifically distinct. Type specimen in my own collection.

* Proc. Roy. Soc. N.S.W., 1893, p. 171.

13. **Clavella tateana**, T. Woods.

*Fusus tateana*, T. Woods, P.R.S.Tas., 1876, p. 94.

*Fusus tateanus*, Tate, Gast. I., 1888, p. 141, pl. xiii., fig. 5.

*Fusus tateana*, Johnston, Geo. Tas., 1888, p. 237, pl. xxix., fig. 6.

*Clavilithes tateanus*, Tate, P.R.S.N.S.W., 1893, p. 170.

14. **Pyrula altispira**, sp. nov. Plate III., figs. 2 and 3.

Shell pyriform, very thin, with a well-elevated obtuse spire, consisting of an embryonic portion of about three smooth, regularly convex, gradually increasing whorls, succeeded by four rapidly increasing ventricose whorls.

Apical angle about one hundred degrees. Earlier spire-whorls convex, penultimate slightly shouldered, body-whorl distinctly shouldered. In the neighbourhood of the aperture that part of the shell between the suture and the shoulder is almost perfectly flat, though gently sloping down to the shoulder, which is at a somewhat lower level than the suture ; posteriorly this portion becomes gradually more and more convex, ultimately losing entirely the appearance it possesses near the aperture. Greatest width of body-whorl a little below the shoulder, thence gradually contracted to the somewhat long and arched canal. Aperture elongate and narrowly oval ; outer lip simple and sharp, at the posterior end straight from the suture to the convexly rounded shoulder, thence gradually and regularly convexly arched to the anterior end of the canal. Columella simple, faintly enamelled, slightly arched to the right, then to the left. Canal long, rather wide, and slightly bent to the left. Surface ornamented with fine, regular, flatly rounded spiral threads, about ten in number in the space between the suture and the shoulder of the body-whorl, and about ten or twelve on the spire-whorls. On the body-whorl, at about its greatest breadth, the spiral threads are coarsest and reach nearly half a millimetre in thickness, thence anteriorly and posteriorly becoming much finer, ultimately very fine at the anterior end of the shell and just discernible on the posterior spire-whorl. Interspaces between the spiral threads about twice the width of the threads, flat and shallow. Both interspaces and spiral threads finely spirally striate, most notice-

able in the interspaces, which carry, where they are about one millimetre in width, five spiral striæ, distinct under a lens. At the anterior end of the shell there is occasionally a finer intercalated spiral thread developed. The spiral ornament is crossed transversely by lines of growth and by fine, strong, close-set striæ parallel to the lines of growth, thus completing the very fine, close, and neat ornament of this species.

*Dimensions.*—Type, length, 62 mm.; breadth, 37 mm.; length of aperture and canal, 54 mm.; greatest breadth of aperture, 18 mm. A smaller specimen gives the following dimensions:—Length, 51 mm.; breadth, 31 mm.; length of aperture and canal, 43 mm.; greatest breadth of aperture, 15 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania. Two examples.

*Observations.*—No species of this genus have hitherto been described from our eocene beds, but the occurrence of the genus at Table Cape has been recorded by Professor Tate in his paper on the "Unrecorded Genera of the Older Tertiary Fauna of Australia"* in the following language:—"This genus is represented in the eocene beds of Table Cape, Tasmania, by a large species, known to me by two examples in the collection of Mr. T. Atkinson; it is undescribed." The specimens referred to above by Professor Tate are those herein described. The elevated spire, the shouldered body-whorl, and the strong spiral ornament, are eminently characteristic of this species, and readily separate it from any of the living species with which I am at present acquainted.

### 15. Siphonalia roblini, T. Woods.

*Fusus roblini*, T. Woods, P.R.S.Tas., 1876, p. 22, pl. i., fig. 7.
*Siphonalia roblini*, Tate, Gast. I., 1888, p. 143.
*Fusus roblini*, Johnston, Geo. Tas., 1888, p. 237, pl. xxix., fig. 8.

### 16. Fasciolaria decipiens, Tate.

*F. decipiens*, Tate, Gast. I., 1888, p. 150, pl. viii., fig. 1.

*Observations.*—Professor Tate has already recognised (*loc. cit.*, pp. 60, 61) that the Table Cape form of this species differs in

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* Proc. Roy. Soc. N.S.W., 1893, p. 173.

several respects from the typical form of *F. decipiens*, from Muddy Creek, and has suggested that it may be desirable when fuller material is at hand to apply distinctive names to them. The material now before me does not seem to justify more than a varietal distinction for the Table Cape form, which only differs from the ordinary Muddy Creek type of the species in that it has a shorter spire, and is a relatively broader and more ventricose form.

### 17. **Peristernia transenna,** T. Woods.

*Fusus transennus*, T. Woods, P.R.S.Tas., 1876, p. 94.

*Peristernia transenna*, Tate, Gast. I., 1888, p. 157, pl. xi., fig. 10.

### 18. **Peristernia affinis,** Tate.

*P. affinis*, Tate, Gast. I., 1888, p. 157, pl. xi., fig. 7.

### 19. **Peristernia aldingensis,** Tate.

*P. aldingensis*, Tate, Gast. I., 1888, p. 156, pl. viii., fig. 8*a*, 8*b*.

*Observations.*—I have very little hesitation in referring the present Table Cape specimens to the above Aldingan species, as I have made careful comparisons not only with Professor Tate's original description and figures of the shell, but also with actual examples of the species from the type locality. Judging, however, from the figures and the dimensions given by Professor Tate, and the specimens from Aldinga in my own collection, the Table Cape specimens are of larger dimensions and are much more solid shells, the dimensions of the latter being as follows :—Length (embryonic whorls and end of canal incomplete), 51 mm. ; breadth, 22 mm. ; length of aperture, 16 mm. ; breadth of aperture, 10 mm. ; length of canal (incomplete), 9 mm.

### 20. **Peristernia murrayana,** Tate, var. **costata,** var. nov.

Plate II., fig. 4.

*P. murrayana*, Tate, Gast. I., 1888, p. 155.

*Observations.*—There are ten examples of this shell in the collection, and after careful study I cannot regard it but as a variety of *P. murrayana*, Tate, a very common fossil in the

eocene beds of the River Murray Cliffs. I happen to have examples of this species from the type locality, as well as from some Victorian localities; and as these agree exactly in every particular with the original description and dimensions given by Professor Tate, I feel every confidence in drawing attention to some of the characteristics of the Table Cape form, which shows a sufficient divergence from the typical Murray Cliffs shell to warrant its recognition as an unrecorded variation to which this species is liable.

The whorls of the Table Cape shell are not so distinctly angulated, and instead of being only tuberculated at the anterior suture of the spire-whorls and at the periphery of the body-whorl, the tubercles are extended into distinct and slightly sigmoidal costæ, which are most highly elevated about the middle of each whorl. The costæ also appear to become more numerous than the tubercles, for Professor Tate states "tubercles small, eight to a whorl," whereas in the present form the costæ increase from about eight in number on the posterior whorl to twelve or thirteen on the body-whorl.

The ornament of the Table Cape shell may be described as follows:—Spiral ornament consisting of a few strong spiral threads with several finer threads intercalated between them. Each whorl bearing from about eight to twelve prominent threads, the three or four on the anterior portion of each whorl usually being the most prominent, with five much finer threads in the interspaces between; of the latter threads the middle one is much stronger than the other two on either side of it. The spiral ornament is crossed transversely by lines of growth, fine sigmoid striæ, and distinct costæ.

The spiral ornament of the Murray Cliffs shell is identical with the above, though one would not be able to judge so with certainty by comparison with the original description instead of with actual specimens.

The dimensions of the largest and best-preserved example from Table Cape are as follows:—Length, 34 mm.; breadth, 16 mm.; length of aperture, 11 mm.; breadth of aperture, 7 mm.; length of canal, 11 mm.

21. **Peristernia semiundulata**, sp. nov. Plate II., figs. 10 and 11.

Shell small, ovately fusiform, moderately thick, with convex or subangulated and strongly costated whorls, and a compatively short canal.

Apical angle about fifty degrees. Embryo consisting of about two-and-a-half convex whorls, the apex of which is slightly excentric. The anterior fourth of the last embryonic whorl, just before joining the first spire-whorl, is closely and slenderly costate, the costæ numbering about six or seven, gradually strengthening anteriorly, the remainder of the embryo being smooth. The spire consists of five very gradually increasing, convex, but occasionally subangulated whorls, with a well-defined and undulating suture. Aperture oval, outer lip thin at the outer edge, but rapidly thickening internally, where it is strongly ridged from the anterior canal to the suture, bearing in this space about twelve or thirteen long ridges, the shallow interspaces being about twice the width of the ridges. Columella bearing one oblique plait at the anterior end of the aperture. Canal somewhat short, very slightly bent to the left and faintly recurved.

Surface ornamented with transverse costæ, striæ, and lines of growth closely crossed by spiral threads. The costæ are well elevated and strongest in the anterior half of each whorl, close set, and convexly rounded, the interspaces usually narrower than the costæ. In number the costæ increase from nine on the posterior whorl to twelve or thirteen on the body-whorl, and are traversed by parallel lines of growth and fine striæ, the latter being usually most noticeable on the posterior slope of each whorl. The transverse ornament is crossed by spiral threads, of which there are about four stronger than the rest developed on the anterior portion of each whorl, and the posterior slope usually bears about three or four finer regularly undulating threads, and in the interspaces there are five much finer threads, of which the middle one is stronger than the pair on either side of it. The intercalated threads are, as a rule, more distinctly visible on the anterior than on the posterior of the whorls. Body-whorl with about twelve of the stronger threads, and with the finer intercalations as above.

*Dimensions.*—Length, 16 mm.; breadth, 8 mm.; length of aperture, 4·5 mm.; breadth of aperture, 3 mm.; length of canal, 4 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania. Three examples. Also in the lower eocene beds of Spring Creek, near Geelong, Victoria.

*Observations.*—The present species apparently shows more affinity with *P. affinis*, Tate, from the same beds than any other hitherto described species, as far as I can make out, but owing to the very brief original description of this species it was not an easy matter to fix its representatives with certainty. From the specimens in the present collection I have identified as *P. affinis* the present described species differs in that the whorls are slightly more convex, the costæ do not extend from suture to suture, but fade away before reaching the posterior suture, the costæ are broader, and on that account appear more crowded, the stronger spiral threads are finer and closer together, and the intercalated finer threads are fewer and not of a uniform size, as in *P. affinis*, which has six or seven fine intercalated threads of uniform size. Further, in *P. affinis* the transverse striæ are much more strongly developed, being nearly as strong as the intercalated threads, thus giving rise to a very fine, neat, and regular cancellation ; also the crossing of the regular and narrow costæ with the stout spiral threads gives rise to a coarse cancellation, which is entirely absent in the new species. Also the columella of the new species is more slender and the canal narrower. This new species shows a certain amount of variability in the number and development of its costæ, but the remainder of its characters appear to be fairly constant. In the Spring Creek representatives the costæ are as a rule fewer in number, ranging from about eight to eleven on the body-whorl.

### 22. Ricinula purpuroides, Johnston.

*Ricinula purpuroides*, Johnston, P.R.S.Tas., 1879, p. 33.
*Pisania purpuroides*, Tate, Gast. I., 1888, p. 165, pl. xi., fig. 6.
*Ricinula purpuroides*, Tate, P.R.S.N.S.W., 1893, p. 173.

### 23. Zemira præcursoria, Tate.

*Id.*, Tate, Gast. I., 1888, pp. 163, 164, pl. xi., fig. 5.

### 24. Phos liræcostatus, T. Woods.

*Cominella lyræcostata*, T. Woods, P.R.S.Tas., 1876, p. 108.
*Phos liræcostatus*, Tate, Gast. I., p. 167, pl. xi., fig. 12.

25. **Lyria semiacuticostata**, sp. nov. Plate II., fig. 8.

Shell somewhat thin, ovate-fusiform, with a well-elevated acute spire, and with the anterior truncated at the end of the short broad canal.

Apical angle about fifty degrees. Spire consisting of a very small obtuse embryo of two-and-a-half smooth, gradually increasing, slightly convex whorls, the apex of which is central, succeeded by six or seven much more rapidly increasing, slightly convex and costated whôrls, with a rather deeply impressed and well-defined suture. Spire-whorls somewhat shouldered at the suture, owing to the form of the transverse costæ, otherwise regularly convex, with their greatest convexity about the middle of each whorl.

Aperture oval, acute posteriorly, and opening into the short broad canal anteriorly; outer lip much thickened, smooth within, gently sloping from the suture, then more suddenly and obliquely inwards as it joins the anterior end of the canal; inner lip with an enamel coating which is thickest at the extremities, almost thinning out medially. Columella with three strong oblique plaits at the anterior end, the medial one being the strongest; these are succeeded by about twelve ridges, gradually diminishing towards the posterior end, the latter being furnished with a strong tooth-like projection a little below the junction of the outer lip with the body-whorl. Canal slightly bent to the right, then recurved.

Surface ornamented with slender, acute, very slightly oblique, transverse costæ, which are most regularly and strongly developed on the earlier or posterior spire-whorls, and tend to become obsolete on the body-whorl, though still visible in some specimens as short angular elevations in the neighbourhood of the suture. The costæ have a more gradual lateral slope on their left side than on their right, where they are much more abrupt, this feature being most noticeable at the posterior suture of each whorl, as it gives rise to the sharp angular terminations at this extremity. Towards their opposite extremity they tend to fade away entirely, as may be noticed on the penultimate and more so upon the body-whorl. In number the costæ are slightly variable, some specimens being more closely costate than others. In all

they increase in number from behind forward, there being about thirteen on the posterior spire-whorl, increasing to from twenty to twenty-seven on the body-whorl. Surface also marked transversely by lines of growth and by very fine parallel striæ.

*Dimensions.*—Type, length, 30 mm.; breadth, 14 mm.; length of aperture, 15 mm.; breadth of aperture, 5 mm. A larger specimen gives the following dimensions:—length, 36 mm.; breadth, 17 mm.; length of aperture, 18 mm.; breadth of aperture, 6 mm.; and the largest specimen yet to hand has a length of 43 mm., and a breadth of 20 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania. Three examples. An undescribed species of Lyria has been obtained by Mr. J. Dennant from the lower eocene beds at Spring Creek, near Geelong, which is, I believe, a representative of the above species.

*Observations.*—Two species of this genus have already been described, *L. harpularia*, Tate, a common eocene shell, and *L. gemmata*, Tate, a rare miocene species. The present species makes the second eocene form and shows many features of general resemblance to our living *L. mitræformis*, from which, however, it is readily separable upon critical examination. The principal differences whereby our fossil may be distinguished from this living species are the less robust shell, the much smaller embryo, more acute spire, less convex whorls, shorter and narrower canal, and its slender, acute and gradually fading costæ, and the absence of spiral grooving at the anterior end of the body-whorl. From our previously described eocene shell, *L. harpularia*, Tate, it may be at once separated by its smaller embryo, more acute spire, less defined shouldering at the suture, non-persistent costæ, and the absence of the spiral striæ, which are usually most distinct at the anterior end of that species. From the miocene shell, *L. gemmata*, it is still further removed and admits of easy distinction, and on that account I think it is hardly necessary to draw attention to any special differential characters.

### 26. Voluta anticingulata, McCoy.

*V. anticingulata*, McCoy, Prod. Pal. Vic. Dec. I., pp. 24-26, pl. vi., figs. 2 to 4.

*V. antiscalaris*, Johnston (*non.* McCoy), Geo. Tas., 1888, p. 237, pl. xxx., figs. 5, 5*a*, 5*b*, and 8.

*V. anticingulata*, Tate, Gast. II., 1889, pp. 133, 134.

*Observations.*—The shell figured by Mr. R. M. Johnston in his Geology of Tasmania is undoubtedly *V. anticingulata*, McCoy, as has already been pointed out by Professor Tate when dealing with this species, and not *V. antiscalaris*, McCoy, which was the name attached by Mr. Johnston to his figure in the explanation of his plate. The record of *V. antiscalaris*, McCoy, must therefore be expunged from the list of Table Cape fossils. *V. anticingulata*, McCoy, is apparently very common at Table Cape, as I now have before me a very large series of specimens which show the same amount of variation in form and ornament as has already been pointed out by Sir F. McCoy as occurring in the specimens from the lower eocene beds of Spring Creek, near Geelong. Thus as the extremes of variation we have *V. anticingulata*, var. *indivisa*, McCoy, in which the subsutural sulcus is entirely absent, the ribs fewer and more sigmoidal, and the shell narrower than in the typical form of the species, also the body-whorl and ribs are often smooth owing to the absence of spiral striæ on that part of the shell; and the other varietal form, to which the name of *V. anticinguiata*, var. *persulcata*, McCoy, has been attached, is also well represented, though not so abundant as the preceding variety, and this is characterised by the more numerous and straighter ribs and by the very strongly developed spiral striæ present on the whole of the body-whorl and spire. Many intermediate forms leading up to these varieties are not of uncommon occurrence, which clearly shows that the way in which this species has been treated by Sir F. McCoy is most certainly correct.

### 27. Voluta weldii, T. Woods.

*V. weldii*, T. Woods, P.R.S.Tas., 1875, p. 24, pl. i., fig. 2.

*V. weldii*, Johnston, Geo. Tas., 1888, p. 237, pl. xxx., figs. 6, 6*a*, 6*b*.

*V. weldii*, Tate, Gast. II., 1889, pp. 134, 135.

*Observations.*—This species is also very common at Table Cape, and shows a considerable amount of variation in form, and especially in the thickness of the shell, the width of the

body-whorl, and in the development of the nodulations on the angulation of the whorls, in some forms being very faint or almost entirely absent, while in others they are very strongly marked.

### 28. Voluta strophodon, var. stolida, Johnston.

*V. strophodon*, McCoy, Prod. Pal. Vic. Dec. IV., pp. 25, 26, pl. xxxvii., figs. 2–4*c*.

*V. stolida*, Johnston, P.R.S.Tas., 1880, p. 36, and Geo. Tas., 1888, p. 237, pl. xxx., figs. 4, 4*a* and 7 (*V. weldii*, Johnston).

*V. strophodon*, Tate, Gast. II., 1889, p. 134.

*Observations.*—Mr. Johnston in the work quoted above figures a shell (pl. xxx., fig. 7) as *V. weldii*, T. Woods, which is clearly not that species. Professor Tate apparently regards it as *V. strophodon*, McCoy ; for my own part I regard it as the young of Johnston's *V. stolida*, figured on the same plate. With regard to *V. stolida*, Johnston, Professor Tate places it amongst the list of unclassified species in his Gastropoda, Part II., p. 121, and merely remarks that it is related to *V. strophodon.* With this I agree, but as the shell shows distinct variation from the typical form of *V. strophodon*, as figured by Sir F. McCoy, it seems to me to be the most satisfactory course at present to retain a varietal name for this form, and it is in this sense that I use Mr. Johnston's name *stolida.*

### 29. Voluta tateana, Johnston.

*V. tateana*, Johnston, P.R.S.Tas., 1879, p. 37, and Geo. Tas., 1888, pl. xxx., figs. 3, 3*a*.

*V. tateana*, Tate, Gast. II., 1889, p. 132, pl. ii., fig. 5.

### 30. Voluta mortoni, Tate.

*Id.*, Tate, Gast. II., 1889, p. 124, pl. ix., figs. 1, 2.

### 31. Voluta stephensi, Johnston.

*V. stephensi*, Johnston, P.R.S.Tas., 1879, p. 35, and Geo. Tas., 1888, pl. xxx., fig. 1.

*V. stephensi*, Tate, Gast. II., 1889, p. 122.

*Observations.*—Professor Tate regards this species as being closely related to *V. heptagonalis* and *V. alticostata*, but, appa-

rently based upon Mr. Johnston's description, differing from them in that it occupies an intermediate position between the two with regard to proportions, in having a greater number of ribs on the body-whorl, which also increase more rapidly in number on the posterior whorls, and in the absence or indistinctness of spiral sculpture. The last mentioned difference does not exist, unless it be in very much rolled and beach-worn specimens. It must have been a very ill-preserved example that came under Mr. Johnston's notice to have enabled him to make such a statement, for the four specimens which I have had the opportunity of examining show strong spiral threads, which number about twenty-four on the posterior whorls, and usually a much finer thread is developed between the strong spiral threads.

### 32. **Voluta ancilloides**, Tate.

*Id.*, Tate, Gast. II., 1889, p. 126, pl. iii., fig. 7.

### 33. **Voluta maccoyii**, T. Woods.

*V. maccoyii*, T. Woods, P.R.S.Tas., 1876, p. 95.

*V. lirata*, Johnston, P.R.S.Tas., 1879, p. 37, and Geo. Tas., 1888, pl. xxx., fig. 10 (*V. allporti*, Johnston, non 1880) (non *V. lirata*, Tate, Gast. II., 1889, p. 130, pl. ii., fig. 4).

*V. agnewi*, Johnston, Geo. Tas., 1888, pl. xxx., fig. 9 (non *V. agnewi*, Johnston, 1880).

*V. maccoyii*, Tate, Gast. II., 1889, p. 126, pl. ii., fig. 2.

*V. polita*, Tate, *op. cit.*, p. 127, pl. ii., fig. 7.

*Observations.*—Considerable confusion has existed with regard to this species, which may now, I think, be cleared up in the following manner. The Rev. J. E. T. Woods in 1876 described *Voluta maccoyii* from the Table Cape beds, and the species described by him is represented in the present collection by twelve examples. In his description he mentions that the whorls have "no other marks than the lines of growth." In some specimens, however, which cannot be separated from this species, some of the lines of growth on the posterior whorls are so much stronger than others that the shells are distinctly lirate posteriorly, at the same time every gradation may be traced between the smooth and lirate forms. Mr. R. M. Johnston in 1879 described

a volute from Table Cape under the name of *V. lirata;* some of the specimens I have of *V. maccoyii*, T. Woods, agree well with the description and dimensions given by Mr. Johnston, and I have therefore no hesitation whatever in regarding the shells before me as Mr. Johnston's species. In 1888 Mr. Johnston published his Geology of Tasmania, and in that work figures a number of Table Cape fossils, amongst which we have, on pl. xxx., fig. 10, a shell evidently intended for *V. lirata*, but for some unknown reason it is referred to in the explanation of the plate as *V. allporti*, Johnston; the latter shell, though somewhat vaguely described, is stated by the author of the species to be the largest volute in the Table Cape beds, somewhat resembling *V. macroptera*, McCoy, but without the wing-like extension of the lip. In view of the above, it is evident that the figure referred to cannot possibly represent *V. allporti*, whereas it agrees fairly well with the description of *V. lirata*.

Mr. Johnston also figures in the same work on pl. xxx., fig. 9, a shell which is called *V. agnewi*, Johnston, which can hardly be said to agree with this description of that species given in 1880. I am inclined to agree with Professor Tate that this figure may represent a form of *V. maccoyii*, T. Woods.

In 1889 Professor Tate figures and describes a shell under the name of *V. lirata*, Johnston, which is most distinctly not that species, but is undoubtedly the same species as that described by him as *V. costellifera*, the latter species being subject to a certain amount of variation in the length of its spire, the breadth of the body-whorl, and the strength or development of the ribs or liræ. *V. lirata*, Johnston, must therefore be expunged from the lists of fossils from the lower beds (eocene) of Muddy Creek, Victoria.

In the same year Professor Tate redescribes and figures *V. maccoyii*, T. Woods, and records it as occurring in the lower beds at Muddy Creek and in the blue clays at Schnapper Point. The Victorian fossil as a rule shows some points of variation from the typical Table Cape form in that it is generally a somewhat more fragile and slender shell, and only occasional specimens show faint transverse liræ on the posterior whorls.

Professor Tate also describes in the same work a shell under the name of *V. polita*, which I am unable to regard as specifically distinct from *V. maccoyii*, T. Woods. Professor Tate distin-

guishes the former from the latter entirely on account of it being proportionately broader, with more convex whorls, a larger though similar pullus, and the presence of five columellar plaits instead of four. After examining fifty-five examples of *V. maccoyii* from the Victorian beds, together with the twelve specimens from Table Cape, I find considerable variation in the proportion of length to breadth, in the convexity of the whorls, in the size of the pullus, and though four columellar plaits seem to be the usual number, I have nine examples of the slender form with five columellar plaits and one example of the broad form with four columellar plaits. It is hardly necessary to mention that, if extreme forms of this species be taken for comparison with one another, one might at first sight experience considerable difficulty in regarding them as the same species, but when a large series of specimens is critically and carefully examined, one is forced to the conclusion that the best method is to regard the species as a variable one, and when we see that this is not an uncommon feature in our Volutes—for example, *V. anticingulata*, McCoy, *V. antiscalaris*, McCoy, *V. strophodon*, McCoy, and *V. weldii*, T. Woods—considerable strength is lent to this conclusion.

### 34. **Voluta pellita**, Johnston.

*Id.*, Johnston, P.R.S.Tas., 1879, p. 36, and Geo. Tas., 1888, pl. xxx., fig. 2.

*Observations.*—Professor Tate places this species in his unclassified list, remarking that it may possibly be *V. ancilloides*, Tate, or *V. macroptera*, McCoy. I cannot regard it as identical with either of these species. *V. ancilloides*, Tate, is a common Table Cape fossil, and the present species differs from it in a very marked manner in general habit and dimensions; the pullus is smaller, less convex, and has a prominently exsert tip; the spire is much more slender; the apertural characters are, however, of the same type in both species. I have not yet seen any examples of *V. macroptera*, McCoy, from the Table Cape beds. Professor Tate records this species based upon examples in the Hobart Museum. It is, however, just possible that imperfect examples of *V. pellita*, Johnston, may have been mistaken for this species. *V. pellita* differs from *V. macroptera* in that the whorls are not

so regularly convexly rounded, in the absence of the wing-like extension of the outer lip, which is thickened as in *V. ancilloides*, in the much smaller pullus and its more marked centrally exsert tip, and in the presence of fine spiral threads, which tend to become obsolete on the body-whorl. Of our other continental species, that to which it is most closely related, and with which it may ultimately prove to be identical, is *V. capitata*, Tate, founded upon one specimen said to have come from a well-sinking in the Murray desert. Apart from size, some of the principal points of divergence appear to be the greater number of turns in the pullus and the presence of an extra plait on the columella of *V. capitata*.

35. **Voluta spenceri**, sp. nov. Plate IV., figs. 1 and 2.

Shell large, moderately thick, broadly fusiform, with an obtusely rounded mammilate apex, and a few strongly nodose and angular whorls, ending in a long and comparatively narrow aperture.

Apical angle about fifty-five degrees. The mammilate embryo consists of about two smooth convex whorls, which are enrolled obliquely, the apex being excentrically immersed. Embryonic whorls narrower than the succeeding spire-whorl, and the axis of their enrolment makes an angle of about one hundred and forty-five degrees with the axis of enrolment of the spire-whorls. Spire consists of five very rapidly increasing strongly nodose-angulose whorls. The angulation of the whorls is situated about the middle of each whorl, becoming slightly nearer the anterior suture anteriorly; the posterior slope is distinctly concave, as is also the case, but to a much less extent, with the more abrupt anterior slope. The posterior slope becomes less steep and more deeply concave as we proceed towards the body-whorl. Aperture elongate and narrowly oval, very acute and drawn out posteriorly, anterior end unfortunately incomplete in the specimens yet to hand. Outer lip very slightly thickened internally, thickest at the suture, near the outer edge it is gently rounded off from within, and ascends as high as the nodulations on the penultimate whorl, its outer margin being faintly undulatory. Inner lip rather thin, thickest near the posterior of the aperture, convexly arched to the columella. Columella slightly twisted and compara-

tively long, bearing a little below the middle of the aperture three unequally-sized oblique plaits, the anterior of which is the strongest. Earliest portion of spire-whorl at first only finely transversely striate, with very faint spiral threads, then bears fine and close transverse ridges or costæ, which become coarser and more nodulose in appearance anteriorly. From this onwards the whorls are strongly nodulose at the medial angulation, the nodules being closer and more numerous on the posterior whorls, where they number about twelve or fourteen, decreasing anteriorly, the body-whorl having only nine; with the decrease in number there is, however, a marked increase in strength and prominence. The nodulations are bluntly rounded, and, as a rule, slightly more abrupt on their right face than on the left, and on the penultimate and earlier part of the body-whorls are extended anteriorly into distinct bluntly rounded, faintly arching costæ, the last four nodules of the body-whorl not being thus extended. The whorls are also traversed by fine and close, yet distinct, transverse striæ and lines of growth, and are further ornamented by numerous (about twenty and upwards on the earlier whorls, increasing in number anteriorly) fine spiral threads with shallow, flat, intermediate furrows. The spiral threads tend to become obsolete on the anterior slope, being entirely absent from this part of the body-whorl, though still discernible on the posterior slope.

*Dimensions.*—Length (pullus and anterior end of canal incomplete), 100 mm.; breadth, 60 mm.; length of aperture (incomplete), 66 mm.; breadth of aperture, 25 mm. In another specimen the pullus is 5 mm. high and 7 mm. broad.

*Locality.*—Eocene beds of Table Cape, Tasmania. One example (type). Also from the eocene clays of Curlewis, Bellarine Peninsula, Victoria.

*Observations.*—This species shows so many characteristic features of its own that it is at once separable from all our hitherto described fossil species, and I am unacquainted with any recent form to which it shows any close resemblance. Amongst our fossil species a certain amount of affinity may perhaps be made out with *V. stephensi*, Johnston; but from this it differs particularly on account of its smaller pullus, its broader form, different shaped whorls, the prominent nodules at the angulation, and also

vening furrows, on the spire-whorls, becoming obsolete on the body-whorl, also transverse lines of growth and fine parallel striations, which become more distinct and somewhat sigmoid on the body-whorl.

*Dimensions.*—Length, 133 mm.; breadth, 67 mm.; length of aperture, 92 mm.; breadth of aperture, 31 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania.

*Observations.*—This very fine volute I have named as a compliment to Mr. E. D. Atkinson, whose careful and extensive collecting from the Table Cape beds has so enriched our knowledge of this particularly interesting fauna. This new species evidently belongs to that group of our eocene volutes typified by *V. hannafordi*, McCoy, but as it does not show any very close relationship to any of our hitherto described species, and has so many characteristic features of its own, any differential remarks seem to be at present unnecessary. There is, however, a very closely related if not identical form from the eocene beds of Birregurra, Victoria, procured by Mr. T. S. Hall from material from that locality; but at present I refrain from expressing an absolute opinion, in the hope that I may be able to obtain more specimens for closer examination.

37. **Voluta halli**, sp, nov. Plate II., figs. 1, 2 and 3.

Shell large, elongate-fusiform, with a small mammilate apex and a long slender spire, terminating in a large, elongate body-whorl, usually with a long and comparatively broad aperture ending in a short, broad canal. Well preserved examples still retaining a high polish.

Apical angle about forty degrees. Embryo mammillate, three to four millimetres in diameter, consisting of about one-and-a-half obliquely enrolled, smooth whorls, the axis of enrolment making an angle with the axis of the spire of about one hundred and forty degrees or slightly upwards. The apex of the embryo is prominently exsert and somewhat eccentric, the exsert portion being very sharply pointed and inclined towards the centre. The spire in the adult form consists of about eight gradually increasing whorls; the earlier spire-whorls are usually flat, occasionally very faintly convex, between the well-defined sutures,

some of the characters of the aperture. Specific name in honour of Professor W. Baldwin Spencer, of the Melbourne University.

### 36. **Voluta atkinsoni**, sp. nov. Plate III., fig. 1.

Shell large, with a mammilate apex and a short conical spire, succeeded by a very large, broad, and strongly shouldered body-whorl, bearing coarse oblique nodosities at the shoulder, with an aperture more than twice the length of the spire.

Apical angle about sixty degrees. Mammilate apex of about one-and-a-half smooth embryonic whorls, which are obliquely enrolled, extreme tip eroded in the example before me, but probably somewhat exsert from its appearance. Succeeding whorls five, suture defined, faintly undulatory, but not impressed. Spire very short, conical, with a slightly concave slope, rather suddenly expanded into the large broad body-whorl, which is nearly four times as long as the spire and a little more than twice as broad. Spire-whorls bearing short, broad, costæ-like nodules, which number about ten to a whorl, reaching from the anterior suture to about the middle of the whorls, thus making the anterior slope of these whorls a little convex, whereas the posterior slope is concave. Body-whorl strongly shouldered, posterior slope concave, anterior slope gently convexly sloping to the attenuated anterior end; on the shoulder there are ten strong oblique nodulations, some of which tend to extend down the whorl and develop into sigmoid costæ.

Aperture prolate-ovate, somewhat effuse anteriorly. Inner lip with a moderately thick enamel pad at the posterior end, posterior canal shallow and narrow; outer lip thick, bevelled off from within, with a moderate outward reflection and a steep and rapid ascent to the nodulations of the penultimate whorl; anterior end of margin where it joins the short and rather broad canal is a little shorter than the columella side. Columella long, stout, slightly twisted, bearing rather high up three unequally sized oblique plaits, the anterior of which is the strongest; the plaits are not easily seen from a front view, as they are situated well within the interior of the aperture.

Surface ornament in addition to the nodular characters already described consists of fine close spiral threads, with shallow inter-

vening furrows, on the spire-whorls, becoming obsolete on the body-whorl, also transverse lines of growth and fine parallel striations, which become more distinct and somewhat sigmoid on the body-whorl.

*Dimensions.*—Length, 133 mm.; breadth, 67 mm.; length of aperture, 92 mm.; breadth of aperture, 31 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania.

*Observations.*—This very fine volute I have named as a compliment to Mr. E. D. Atkinson, whose careful and extensive collecting from the Table Cape beds has so enriched our knowledge of this particularly interesting fauna. This new species evidently belongs to that group of our eocene volutes typified by *V. hannafordi*, McCoy, but as it does not show any very close relationship to any of our hitherto described species, and has so many characteristic features of its own, any differential remarks seem to be at present unnecessary. There is, however, a very closely related if not identical form from the eocene beds of Birregurra, Victoria, procured by Mr. T. S. Hall from material from that locality; but at present I refrain from expressing an absolute opinion, in the hope that I may be able to obtain more specimens for closer examination.

### 37. **Voluta halli**, sp, nov. Plate II., figs. 1, 2 and 3.

Shell large, elongate-fusiform, with a small mammilate apex and a long slender spire, terminating in a large, elongate body-whorl, usually with a long and comparatively broad aperture ending in a short, broad canal. Well preserved examples still retaining a high polish.

Apical angle about forty degrees. Embryo mammillate, three to four millimetres in diameter, consisting of about one-and-a-half obliquely enrolled, smooth whorls, the axis of enrolment making an angle with the axis of the spire of about one hundred and forty degrees or slightly upwards. The apex of the embryo is prominently exsert and somewhat eccentric, the exsert portion being very sharply pointed and inclined towards the centre. The spire in the adult form consists of about eight gradually increasing whorls; the earlier spire-whorls are usually flat, occasionally very faintly convex, between the well-defined sutures,

becoming more convex anteriorly. Aperture elongate oval, somewhat effuse anteriorly, acute posteriorly, and with a short and very broad anterior canal. Outer lip thickened at the edge, slightly reflected outwardly and gently rounded off from within, ascending the penultimate whorl for a short distance, but barely reaching as high as the middle of that whorl. Outer lip has a fairly regular, convexly arched slope to the anterior canal, which it joins a little higher up than the opposite end of the columellar side. Inner lip thickest near the suture, where it forms a thickish enamel coating thinning out towards the columella. Columella comparatively long and slender, slightly twisted, and bearing at its upper part three strongly oblique plaits decreasing in strength posteriorly.

Earlier whorls ornamented with from about fifteen to twenty-five fine spiral threads, with narrower interspaces, the threads being stronger in the neighbourhood of the sutures than at the middle of the whorls, ultimately becoming obsolete anteriorly. The spiral ornament is crossed transversely by fine, close, and regular striæ parallel to the lines of growth, becoming more distinct as the spiral threads weaken and vanish. Body-whorl with very numerous striæ and slight undulations parallel to the lines of growth.

*Dimensions*—Length, 165 mm.; breadth, 67 mm.; length of aperture, 87 mm.; breadth of aperture, 40 mm.; breadth of anterior notch, 20 mm. The Table Cape representative in the present collection is a younger shell and has only attained the length of 110 mm. Young examples of this species are not at all uncommon, many examples of about 60 mm. in length and less being easily obtained at some of our Victorian localities. Taking the length as 100, the relative breadth varies from about 37 to 45, the latter being the above large example.

*Locality.*—Eocene beds of Table Cape, Tasmania. Common in the lower eocene beds at Spring Creek, near Geelong, also in the eocene clays of Curlewis, Bellarine Peninsula, Victoria.

*Observations.*—One of the adult specimens I have from Spring Creek, though very much the same as the above, still shows a few important characters which at present seem to warrant its recognition at least as a varietal form. Some of the principal features of this form being that the spire-whorls are a little more convex,

the penultimate whorl and the one preceding it are angulate or keeled about their middle line, the posterior slope being faintly concave, while the anterior slope is flat or slightly convex, the body-whorl is also shouldered, the aperture is narrower and less effuse, and the outer lip is not so distinctly reflected. In the main apparently similarly ornamented to the above on the earlier spire-whorls, but the body-whorl shows below the shoulder about eight or ten widely separated, obscure, very broad, and scarcely raised spiral ridges or bands, one of the strongest being near the anterior end of the whorl. The dimensions of a large example of this variety are: length, 157 mm.; breadth, 58 mm.; length of aperture, 90 mm.; breadth of aperture, 27 mm. It might be further mentioned that some of the young examples show a few widely separated spiral ridges about their periphery of a much stronger character than the earlier spiral threads. These young examples are also finely spirally threaded and grooved at their anterior end. The present species is somewhat related to *V. macroptera*, McCoy, but it is a very much more slender and flatter spired form, with a much smaller pullus, and no wing-like extension of the outer lip, which only slightly ascends the penultimate whorl, and is thickened at its outer edge. It also shows some relation to *V. pellita*, Johnston, but may be easily distinguished from that species by the smaller size of its pullus, its slender, elongate, and flat-whorled spire, and by its large, broad, and effuse aperture. Type in my own collection.

### 38. **Voluta alticostata**, Tate.

*Id.*, Tate, Gast. II., 1889, p. 122, pl. v., fig. 7.

*Observations.*—A very fine entire representative of this species is in this collection, and as it has been compared with a perfect example of my own from Muddy Creek, the type locality of the species, there can be no doubt about its identity. However, as it is very much larger than any hitherto recorded example of the species, I think it well to record the dimensions, which are as follows:—Length, 185 mm.; breadth, 85 mm.; length of aperture, 110 mm.; breadth of aperture, 45 mm. A very much larger example of this species, being over a foot in length, is in the Melbourne National Museum, where it is labelled, though, as I think, erroneously, *Voluta hannafordi*, McCoy, and was obtained

from Muddy Creek. From the above there can be no doubt that this is the largest of our Australian Older Tertiary volutes as yet discovered.

### 39. **Mitra dictua**, T. Woods.

*M. dictua*, T. Woods, P.L.S.N.S.W., 1879, p. 8, pl. iii., fig. 7.
*M. dictua*, Tate, Gast. II., 1889, p. 137, pl. iv., fig. 9.

### 40. **Mitra anticoronata**, Johnston.

*Id.*, Johnston, P.R.S.Tas., 1879, p. 34.

### 41. **Ancillaria pseudaustralis**, Tate.

*A. australis*, T. Woods (non. Sowerby), *fide* Tate, P.R.S.Tas., 1884, p. 209.

*A. mucronata*, T. Woods (non. Sowerby), P.R.S.Tas., 1874, p. 17.

*A. mucronata*, Johnston (non. Sowerby), Geo. Tas., 1888, pl. xxxi., fig. 12.

*A. pseudaustralis*, Tate, Gast. II., 1889, pp. 148, 149, pl. vi., fig. 13, and pl. vii., fig. 1.

*Observations.*—Not uncommon at Table Cape, but the abundant form which occurs is not the typical slender spired form so common in the lower beds at Muddy Creek and figured by Professor Tate on plate vii., fig. 1, in the work above referred to, but the very broad apically obtuse form recorded from a well-sinking in the Murray desert and from the River Murray cliffs, and figured by Professor Tate on plate vi., fig. 13.

### 42. **Terebra additoides**, T. Woods.

*T. additoides*, T. Woods, P.R.S.Tas., 1876, p. 95.
*T. additoides*, Tate, Gast. II., 1889, p. 163.

### 43. **Terebra prægracilicostata**, sp. nov. Plate II., fig. 9.

Shell small, narrowly elongate and very acute spiral, with small and convex embryonic whorls and rather flat and very slenderly costate spire-whorls, terminating with a narrow aperture and very short canal.

Apical angle about fifteen degrees. Embryo consists of about three smooth, regularly convex, gradually increasing whorls, the tip of which is central but not prominently exsert so far as the

present examination goes. Embryonic whorls succeeded by eight spire-whorls, which are slightly more convex posteriorly and become flatter anteriorly, with a moderately well-defined suture, but no well-marked subsutural groove or sulcus; anterior slope of body-whorl somewhat abrupt. Aperture narrow elongate-oval; outer lip thin and simple, somewhat thickened at the suture. Columella simple and slightly arched. Canal very short, comparatively wide, and a little upturned at the anterior end. At the base or anterior end of the shell a prominent ridge runs round from the anterior outer end of the canal just up to the columella.

Surface ornamented with very slender acute costæ, with much wider and shallow interspaces between. The interspaces become wider anteriorly, being about twice or slightly more than twice the width of the costæ on the body and penultimate whorls. The costæ are practically straight, very slightly elevated above the general surface of the shell, number twelve to a whorl and are smooth. Below the posterior suture of each whorl there is a tendency towards the development of a subsutural depression, which, however, has only affected the costæ, and the latter on this account appear faintly tuberculate in this region. The surface also shows fine lines of growth and striations parallel to the costæ, but the only spiral ornament consists of exceedingly faint and microscopic striations, which are not visible to the unaided eye.

*Dimensions.*—Length of eight whorls with embryo, 13 mm.; breadth of body-whorl, 3·5 mm.; length of aperture and canal, 3 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania.

*Observations.*—This form seems at present sufficiently distinct from our previously described species of the genus to necessitate its record as new. It however shows some affinity with *T. additoides*, T. Woods, from beds of the same horizon, and with *T. leptospira*, Tate, from the eocene beds of Muddy Creek. From *T. additoides* it may be distinguished by its more slender and rapidly tapering spire, flatter whorls, much less numerous costæ (or plicæ as they are referred to in the description of that species), and the absence of the distinct subsutural band; and from *T. leptospira* it is also I believe distinct, but owing to the exceed-

ingly brief and vague description of this species I can only fall back on the accompanying figure for differential characters, and from this I judge that the present species differs in its embryonic characters, its more rapidly tapering spire, its slightly more convex whorls, and its much smaller number of different costæ or plicæ.

### 44. Semicassis sufflata, T. Woods.

*Cassis sufflatus*, T. Woods, P.R.S.Tas., 1876, pp. 93, 94.

*Semicassis transenna*, Tate, Gast II., 1889, p. 166, pl. viii., fig. 2.

*Observations.*—There seems no doubt that the shell described by Professor Tate under the name of *S. transenna* is the same species as that previously described by Tenison Woods under the name of *C. sufflatus*. The latter name should certainly stand, as it clearly has priority.

### 45. Cassidaria wilsoni, Tate.

*Id.*, Tate, Gast. II., 1889, p. 169, pl. vii., fig. 14.

### 46. Marginella strombiformis, T. Woods.

*M. strombiformis*, T. Woods, P.R.S.Tas., 1876, p. 109.

*M. strombiformis*, Tate, Phil. Trans. S.A., 1878, p. 93.

*M. strombiformis*, Johnston, Geo. Tas., 1888, pl. xxxi., figs. 4, 4*a*.

### 47. Cypraea ovulatella, Tate.

*Id.*, Tate, Gast. III., 1890, p. 208, pl. vi., figs. 7, 7*a*.

*Observations.*—The present example apparently differs only in size from that described by Professor Tate, being of nearly twice the dimensions given by him.

### 48. Cypraea archeri, T. Woods.

*C. archeri*, T. Woods, P.R.S.Tas., 1875, p. 23, pl. 1, fig. 9.

*C. archeri*, Tate, Gast. III., 1890, p. 205, pl. vi., fig. 1.

### 49. Cypraea platypyga, McCoy.

*C. platypyga*, McCoy, Prod. Pal. Vic., Dec. III., p. 39, pl. xxx., figs. 1–1*c*.

*C. platypyga*, Tate, Gast. III., 1890, p. 211.

### 50. **Cypraea sphærodoma?**, Tate.

*Id.*, Tate, Gast. III., 1890, p. 209, pl. viii., fig. 5.

*Observations.*—It is with some hesitation that I record this species as occurring at Table Cape, owing to the incompleteness of the example before me, but after careful examination I have been unable to refer it to any other species.

### 51. **Cypraea platyrhyncha,** McCoy, var. **angustior,** var. nov. Plate IV., figs. 8 and 9.

*C. platyrhyncha*, McCoy, Prod. Pal. Vic., 1876, Dec. III., p. 40, pl. xxx., figs. 2–2*c*.

*Observations.*—As the common Table Cape shell shows some important departures from the type and usual form in the lower beds of Spring Creek, near Geelong, it seems to me advisable to regard these characters as of sufficient value for the introduction of a varietal name. Sir F. McCoy, when describing this species, has already remarked on some variation from the type form, for whereas the rostrum in the type is broad and flattened like a duck's bill, he has noticed narrower specimens, one or two which show a slight indication of the two anterior dorsal tubercles, and a variation in the number of teeth on the outer lip. The characters upon which I base this varietal name are the usually smaller size of the shell, the much more rapidly tapering and on that account narrower anterior end, the moderately strong development of the two anterior dorsal nodulations or tubercles, the less unequal growth and thickening of the two sides of the posterior canal, the direct effuseness over the spire of the posterior canal, the tendency to upturning of the anterior end and canal, and the stronger development and greater number of teeth on both lips. Sir F. McCoy's description of the mouth of *C. platyrhyncha* is as follows :—" . . . mouth narrow, flexuous, nearly edentulous, the posterior half and anterior fourth of both lips without teeth, the intervening quarter of the length of the outer lip having about twelve obtuse small teeth on the edge, the corresponding portion of inner lip with still smaller and fewer similar teeth, not extended as sulci over the base." In the present variety the anterior fourth of both lips is as above without teeth, but the remainder of the outer lip is toothed right up

to the posterior canal, and the teeth usually number about twenty-two; the inner lip in some specimens is also toothed for its full remaining length, with the same number of similar though smaller teeth, whereas in others they show a marked tendency to become obsolete at the posterior end. In one well-preserved example showing this tendency I have still been able to count sixteen distinctly visible teeth on this lip. All these points of difference are at first sight striking, and might be regarded as of specific value, but a close examination of a number of specimens will, I think, convince anyone that we are not dealing with more than an extreme form of *C. platyrhyncha*, McCoy.

*Dimensions of var. angustior.*—Length, 68 mm.; breadth, 33 mm.; height, 29 mm.; breadth at anterior end, 8 mm. Smaller specimens of about the following average dimensions also occur:—Length, 57 mm.; breadth, 28 mm.; height, 22 mm.; breadth at anterior end, 6·5 mm.

### 52. **Conus complicatus**, Tate.

*Id.*, Tate, Gast. III., 1890, p. 195, pl. viii., fig. 8.

### 53. **Daphnella gracillima**, T. Woods.

*Id.*, T. Woods, P.R.S.Tas., 1876, p. 106.

### 54. **Bela tenuisculpta**, T. Woods.

*Daphnella tenuisculpta*, T. Woods, P.R.S.Tas., 1876, p. 106.
*Bela tenuisculpta*, Tate, T.R.S.S.A., 1894, p. 221.

### 55. **Raphitoma columbelloides**, T. Woods.

*Daphnella columbelloides*, T. Woods, P.R.S.Tas., 1876, p. 105.
*Pusionella columbelloides*, Tate, T.R.S.S.A., 1894, p. 221.

### 56. **Bela woodsii**, Tate.

*Cominella cancellata*, T. Woods, P.R.S.Tas., 1876, pp. 107, 108.
*Bela woodsii*, Tate, Gast. I., 1888, pl. iv., fig. 3.

### 57. **Pleurotoma paracantha**, T. Woods.

*Id.*, T. Woods, P.R.S.Tas., 1876, p. 105.

### 58. **Pleurotoma johnstoni**, T. Woods.

*Id.*, T. Woods, P.R.S.Tas., 1876, p. 105.

*Observations.*—The Rev. J. E. Tenison Woods' description of this species is somewhat vague and difficult to grasp exactly, but I think that the present form represents his species; the specimens before me are however much larger than those indicated by his dimensions, having a length of 77 mm.; breadth, 22 mm.; length of aperture, 41 mm.; breadth of aperture, 9 mm.

### 59. **Pleurotoma wynyardensis**, sp. nov. Plate II., figs. 12 and 13.

Shell of small to medium size, somewhat narrow elongate-fusiform, aperture and canal about the same length as the spire; spire acute, made up of a rather small embryonic portion, succeeded by numerous, gradually increasing, convex, and more or less strongly costated whorls. Apical angle about twenty-five to thirty degrees. Embryo rather small, consisting of about one-and-a-half smooth convex whorls. Spire consisting of seven or eight regularly convex whorls, with their greatest convexity about the middle of each whorl, and with a well-impressed suture. Aperture oval; outer lip rather thin and smooth internally, with a well-defined broad but comparatively shallow sinus just below the suture, from the sinus the lip projects slightly forward with a regular convex arch, then curving downwards to join the anterior canal. Sinus about one to one-and-a-half millimetre broad, but usually only about half this measurement in depth. At the anterior end the aperture opens into a long, straight, slender and open canal, which is much longer than the aperture. Inner lip with a thin enamel coating. Columella simple and smooth, straight, slender, and gently tapering to the anterior end. Surface ornamented with oblique costæ, which are most highly elevated about the middle of each whorl, and fade off more rapidly towards the posterior suture than the anterior. Costæ usually nine to a whorl, an occasional example shows as many as eleven or twelve on the body-whorl. Strength of development of costæ somewhat variable, especially on the anterior whorls, where they are occasionally only just visible. The costæ are traversed by comparatively coarse and fine spiral threads. Of these there are four to six coarser and more prominent than the rest, situated in the anterior two-thirds of each whorl, especially prominent where they cross the costæ, more numerous, amounting to about eight or nine, on the body-whorl, with much broader interspaces between

each of which has a medial finer thread with a pair of still finer threads on either side of it. The posterior third is occupied by from about ten to fifteen very fine spiral threadlets, also the fine lines of growth of the sinus are in this space. Both costæ and spiral threads are traversed by the fine oblique forwardly directed lines of growth.

*Dimensions.*—Length, 27 mm.; breadth, 8 mm.; length of aperture, 6 mm.; breadth of aperture, 3 mm.; length of canal, 8 mm. Some of the young examples of this species in the collection have only attained the length of 13 mm.

*Locality.*—Not uncommon in the eocene beds of Table Cape, Tasmania, also in the lower beds of the lower eocene series at Spring Creek, near Geelong, Victoria.

*Observations.*—This species, as is commonly the case in the genus to which it belongs, shows a considerable range of variation, especially in the ornament. In the present form the costæ and spiral threads vary in number and in strength. In some examples the former become so weak on the anterior whorls that it would not be surprising, should examples subsequently turn up, in which the costæ had become altogether obsolete on the body-whorl. I am not at present acquainted with any living species which shows any marked affinity with the present form.

60. **Drilia crenularoides**, sp. nov. Plate III., figs. 6 and 7.

Shell moderately large, narrow-elongate, spire many-whorled and longer than the aperture and canal, whorls nodulosely costate, with a rather well marked subsutural concavity, sinus in this region well-defined, moderately broad and deep, canal rather short and straight.

Apical angle about twenty-five degrees. Embryonic whorls unfortunately missing. Spire consisting of about eight convex whorls, greatest convexity about the middle of each whorl, the posterior third of each whorl rather deeply concave immediately under the suture, which gives the appearance to this part of the shell of rather a strong overlap of the whorls, anterior two-thirds convex, most marked at the costæ.

Aperture oval, somewhat contracted posteriorly, and gradually drawn out anteriorly into a short, slightly curved and open canal, which is about the same length as the aperture. Outer lip thin and slightly crenulated at the outer edge with a very

distinct, broad and deep sinus just below the rather prominent subsutural band and situated in the concave posterior third. Sinus about half as deep again as broad, thence the outer lip projects prominently forward, then gently arched to join the anterior canal. Columella simple, slightly bent and tapering.

Posterior whorls ornamented with slightly oblique costæ, developed in the anterior two-thirds of the whorls and extending right up, though gradually fading, to the anterior suture, thus leaving the posterior third practically free from costulate elevations. On the anterior whorls the costæ fade sooner towards the anterior suture, though strongly elevated and prominent medially, giving rise to the appearance rather of a medial band of nodules or tubercles than to fully-developed costæ. Costæ or tubercles number about nine to a whorl. Spiral ornament consists of four or five strong spiral threads in the anterior two-thirds of each whorl, while the body-whorl shows about eight or nine, and one strong thread just adjacent to the posterior suture, making rather a prominent and characteristic subsutural band. On the posterior whorls the anterior group of threads are comparatively broad, with narrower grooves between, but anteriorly the grooves widen out till on the penultimate whorl the grooves or interspaces are broader than the threads, and become still more distinctly so on the body-whorl. As the grooves widen out much finer spiral threads become visible in this space, the interspaces on the body-whorl showing three of these finer intercalated threads. In the concave space between the subsutural band and the threads of the anterior portion of the whorl, which is occupied by the growth-lines of the sinus, there are two or three fine spiral threads, with still finer threads, just visible under a lens, on either side of them. The costæ and spiral ornament are both traversed by fine and close lines of growth, which by their marked sinuation and forward curvature clearly indicate the nature and position of the shell.

*Dimensions.*—Length, 24 mm. (without embryonic whorls); breadth, 8 mm.; length of aperture, 6 mm.; breadth of aperture, 3 mm.; length of canal, 6 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania. An imperfect specimen from Spring Creek, Victoria, probably represents this species.

*Observations.*—This species recalls and apparently has some affinity to some of the forms of the living species, *D. crenularis*, Lamarck, from North Australia and Singapore, and the form to which it appears most closely related is that represented by Tryon in his Manual of Conchology, pl. x., fig. 69, from this it is separable principally by its narrower and slightly longer canal, more slender columella, fewer costæ, and different details of ornament.

### 61. Natica wintlei, T. Woods.

*N. wintlei*, T. Woods, P.R.S.Tas., 1875, p. 23, pl. i., fig. 3.
*N. wintlei*, Johnston, Geo. Tas., 1888, pl. xxix., fig. 10.
*N. wintlei*, Tate, Gast. IV., 1893, pp. 322, 323.

### 62. Natica subnoæ, Tate.

*N. subnoæ*, Tate, Gast. IV., 1893, p. 320, pl. vi., fig. 1.

### 63. Natica vixumbilicata, T. Woods.

*N. ovata*, T. Woods (*non* Hutton), P.R.S.Tas., 1875, p. 17.
*N. vixumbilicata*, T. Woods, *op. cit.*, 1876, p. 111.
*N. vixumbilicata*, Tate, Gast. IV., 1893, pp. 320, 321, pl. x., fig. 9.

### 64. Natica polita, T. Woods.

*N. polita*, T. Woods, P.R.S.Tas., 1875, p. 23, pl. i., fig. 4.
*N. polita* (*forma typica*), Tate, Gast. IV., 1893, p. 325.
*N. polita*, (*forma inflata*), Tate, *loc. cit.*

### 65. Natica, n. sp.

*Observations.*—This shell is only represented by one example in the present collection, and appears to be entirely distinct from any of our already recognised species; but taking into consideration the fact that most of our common fossil representatives of this genus are subject to no small amount of variation, I refrain from attaching a specific name and rearing up a new species upon this single specimen. The form now under examination may be said to show some affinity to *N. wintlei*, T. Woods, from the same beds, and to *N. aldingensis*, Tate, from the eocene beds of Aldinga, South Australia.

With some of the larger forms of *N. wintlei* it agrees somewhat in umbilical and apertural characters, but does not appear to have any funicular ridge or rib, a feature usually most noticeable in medium-sized specimens of that species. In the characters of this region it makes a closer approach to *N. aldingensis*, but the umbilicus is not so open or so deep. In the shape of the body-whorl it again approaches *N. aldingensis* rather than *N. wintlei*, but differs most markedly from both these species in its very short, small, and depressed spire of about the same number, though much more flattened and hidden whorls. I have not been able to make out any distinct spiral threading or ornament, but fine centrifugal lines of growth and parallel striæ are very well-marked on the spire and body-whorl.

### 66. Calyptræa subtabulata, Tate.

*Trochita calyptræformis*, Johnston (*non* Lamarck, *non* Deshayes) P.R.S.Tas., 1876, p. 86, and Geo. Tas., 1888, pl. xxix., figs. 14, 14*a*.

? *Pileopsis navicelloides*, Johnston, P.R.S.Tas., 1879, p. 39.

*Calyptræa subtabulata*, Tate, Gast. IV., 1893, p. 332, pl. vii., fig. 1.

### 67. Turritella warburtoni, T. Woods.

*T. warburtoni*, T. Woods, P.R.S.Tas., 1876, p. 99.

*T. sturtii*, T. Woods, *loc. cit.*

*T. warburtoni*, Tate, Gast. IV., 1893, pp. 337, 338, pl. viii., fig. 2.

*T. sturtii*, Tate, *loc. cit.*, pl. viii., fig. 6.

*Observations.*—Professor Tate's description of this species differs from the original description of Tenison Woods, noticeably in that the latter lays a certain amount of stress upon the presence of "*two smooth* conspicuous ribs at the lower part of each whorl, with others very fine and of varying size above;" whereas Professor Tate describes the species as bearing "two anterior ribs more or less granulose, each of the interspaces between the keels with two or three fine threads of varying size." It is evident from this that Professor Tate saw some variation in this species which he thought fit to draw attention to in the above manner. At the same time the fact has been overlooked

that the form described by Professor Tate under the name of *T. warburtoni* is intermediate between those described by Tenison Woods under the names of *T. warburtoni* and *T. sturtii*, the latter being characterised by Tenison Woods in the matter of ornament as follows :—"The three prominent ribs on the whorls are all granular, the larger two at the base of the whorl, and the third above and separated by a wide interval in which smaller ribs occur." Again, Professor Tate's description of *T. sturtii* differs from the original of T. Woods in that he remarks :—"Prominent ribs three, equidistant, of which the median and anterior ones are granulose, the posterior one often double, each interspace with about two fine spiral threads."

From the above remarks it can be readily seen that there is considerable variation in the ornamentation of these Turritellas, and Professor Tate's redescriptions of T. Woods' species, together with my own observations on a very large number of specimens (upwards of 150), constrains me to the belief that we are merely dealing with an extremely variable form, which would be better designated by the one name, *T. warburtoni*, T. Woods, than by an indefinite multiplication of species. The extreme difference in shape to which this species is subject is fairly well represented by Professor Tate's figures to Gastropoda, Part IV., pl. viii., figs. 2, 2*a*, 2*b*, and 6, 6*a*, 6*b*, but in a large series intermediate forms are not uncommon.

The apex is described by Professor Tate as consisting of "two-and-a-half smooth turns" in the one case (*T. warburtoni*) and "three small, smooth, rounded turns" in the other (*T. sturtii*). We are unable to compare this part of the description with that of T. Woods, as he simply says, in both instances, "apex always decollated."

As the specimens described by T. Woods under both these specific names were evidently imperfect examples, I cannot gain any reliable information as to the number of whorls. Professor Tate, however, states that *T. warburtoni* has fifteen whorls in a length of 9·5 mm., while T. *sturtii* has the same number of whorls in 12 mm. In my examination of apically perfect specimens I find considerable variation in the number of whorls in a definite length, and as would naturally be expected, the more acute varieties are those which possess the greatest number of

whorls. We have in this particular an exactly parallel case in the succeeding species, *T. murrayana*, and in the latter case it is extremely readily detected, as it is on a so much larger scale.

## 68. Turritella murrayana, Tate.

*Torcula murrayana*, Tate, P.R.S.Tas., 1884, p. 227.

*Turritella murrayana*, Tate, Gast. IV., 1893, pp. 340, 341, pl. viii., fig. 3.

*Observations.*—The variation to which this species is subject has already been dealt with to a certain extent by Professor Tate in his Part IV. of our Tertiary Gastropoda; but as my study of this collection of Table Cape Fossils has led to the consideration of forms varying beyond the limits already expressed, I think it well to include here the additional observations.

In the typical form, according to Professor Tate's description, there are twelve to fourteen whorls, an apical angle of about 15 deg., length 60 mm., breadth 17 mm. Professor Tate also notes that the Table Cape form is usually proportionately broader, the apical angle being as much as 18 deg. The specimens I now have under examination from the same locality show a much greater extreme in this direction, for in ten whorls the length is 86 mm. and the breadth 30 mm., while the apical angle is 22 deg. Another example of ten whorls, though still widely divergent from the type, shows a slight diminution in measurements from the preceding, in that its length is 70 mm., breadth 26 mm., and apical angle 21 degrees.

While dealing with this point it may not be out of place to record further variation in the opposite direction. In this case the specimens come from the eocene beds of Shelford, near Geelong, and are extremely slender, many-whorled forms, examples with sixteen whorls being 71 mm. in length, while only 15 mm. in breadth, and with an apical angle of only 12 degrees.

The above seems to my mind to give additional confirmation, if any were requisite, for the way in which I have dealt with *T. warburtoni*, T. Woods.

## 69. Turritella conspicabilis, Tate.

*T. conspicabilis*, Tate, Gast. IV., 1893, p. 339, pl. viii., fig. 7.

### 70. **Thylacodes rudis**, Tate.

*T. rudis*, Tate, Gast. IV., 1893, p. 343, pl. ix., fig. 8.

### 71. **Tenagodes occlusus**, T. Woods.

*Tenagodus occlusus*, T. Woods, P.R.S.Tas., 1876, p. 100.

### 72. **Potamides pyramidale**, Tate.

*Id.*, Tate, P.R.S.Tas., 1884, p. 226.

### 73. **Potamides semicostatum**, Tate.

*Id.*, Tate, P.R.S.Tas., 1884, p. 226.

### 74. **Rissoa dubia**, Johnston.

*Id.*, Johnston, P.R.S.Tas., 1879, p. 33.

*Observations.*—Owing to the very brief description of this species it is a somewhat difficult matter to come to an absolutely definite conclusion; but the present specimen, after careful examination, I am unable to distinguish as distinct from Mr. Johnston's description, except that it is twice as large as the specimen of which he gives the dimensions.

### 75. **Astralium flindersi**, T. Woods.

*A.* (Calcar) *flindersi*, T. Woods, P.R.S.Tas., 1876, p. 95.

### 76. **Astralium ornatissimum**, T. Woods.

*A.* (Calcar) *ornatissimum*, T. Woods, P.R.S.Tas., 1876, p. 96.

### 77. **Astralium (Imperator) johnstoni**, sp. nov.

*Imperator* (Astralium) *imperiale?* R. M. Johnston, P.R.S.Tas., 1876, p. 90*c*.

*Imperator hudsoniana*, R. M. Johnston, Geo. Tas., 1888, pl. xxix., figs. 12, 12*a*.

*Imperator tasmanica*, R. M. Johnston, MS., *op. cit.*, p. 239.

*Description.*—Shell large, depressed trochiform, somewhat thick, consisting of a few flatly convex whorls, which are spirally ornate and strongly keeled, the keel bearing strong erect and forwardly projecting scales, and with a very deep umbilicus. Embryo

unknown, all the examples at present under examination being imperfect in this respect. Spire-whorls about four in number, rapidly increasing in size to the large and broad body-whorl, almost perfectly flat at first near the posterior suture, then flatly convex to the well-developed and characteristic keel, the latter being situated so close to the anterior suture that owing to its strong development and ornamentation the suture is completely hidden. Body-whorl keeled at the periphery, base almost flat, being slightly convexly rounded from the keel to the umbilicus. Aperture oval, nacreous internally, peristome almost continuous, but falls a little short at the posterior of the inner lip. Outer lip smooth internally, thin at the edge, and slightly crenulated at the ends of the coarse spiral threads; inner lip strongly reflected over the umbilicus. Umbilicus nearly circular, wide, and very deep, penetrating up the spire as far almost as the embryonic whorls, rather strongly angled by two revolving keels. The surface ornament consists of coarse and fine granulose or squamose spiral threads and a strong peripheral keel. The keel carries a number of stout, erect, forwardly projecting and very prominent scales, which are ornamented with fine threads in uniformity with those of the same degree of strength on the remainder of the shell. In a large specimen these peripheral scales number about twelve on the body-whorl, in smaller examples they are slightly less in number. Basal ornament consists of about six or seven coarse spiral threads, which bear numerous and comparatively coarse forwardly projecting scales, commonly, however, worn down to a more or less granulose appearance; intercalated between these are finer threads, which are similarly though not so coarsely ornamented. The spiral ornament is crossed by close, fine, and slightly raised lamellæ parallel to the lines of growth. Umbilicus partly margined by a revolving area, which only shows the lamellæ of growth, and partly by an area bearing spirally revolving threads similar to those above described.

*Dimensions.*—Height about 30 mm.; breadth to extremities of peripheral scales, 66 to 69 mm.; height of aperture, about 19 mm.; breadth of aperture, 27 mm.; width of umbilicus, 11 mm. Much smaller specimens occur having a basal diameter of from 32 mm. to 40 mm.

*Locality.*—Eocene, Table Cape, Tasmania. Also from the eocene ferruginous beds of Keilor (T. S. Hart), and Royal Park (Rev. Mr. Ramage), and from the eocene limestones (upper beds) of Moorabool Valley, at Maude.

*Observations.*—I have taken the liberty of describing and renaming this species owing to the very unsatisfactory and unrecognisable condition in which I find it. In the first place Mr. R. M. Johnston recorded with a doubt the occurrence of the living New Zealand species, *Astralium* (*Imperator*) *imperiale*, Chemnitz. This record in all probability refers to the present species, which, however, is undoubtedly distinct from its living analogue. When next we meet with an *Imperator* in Mr. Johnston's Geology of Tasmania, we find two figures on plate xxix. to which the name of *I. hudsoniana*, R. M. Johnston, is attached in the explanation of the plate; but upon looking up the list of Table Cape species given by the same author in the same work, the only *Imperator* there recorded is *I. tasmanica*, R. M. Johnston, MS. As I have been unable to find any description which goes with either of these names, and as the figures given of *I. hudsoniana* do not render its identification anything but a matter of extreme doubt, I have concluded to describe the shell and dedicate the species to Mr. R. M. Johnston.

The type specimens are in my own collection.

### 78. **Liotia lamellosa**, T. Woods.

*L. lamellosa*, T. Woods, P.R.S.Tas., 1876, pp. 96, 97.
*L. lamellosa*, Tate, *op. cit.*, 1884, p. 210.

### 79. **Turbo etheridgei**, T. Woods.

*T. etheridgei*, T. Woods, P.R.S.Tas., 1876, pp. 98, 99.

### 80. **Turbo atkinsoni**, sp. nov. Plate III., fig. 12.

Shell somewhat thick in the adult form, conical, nacreous internally, with a well-elevated spire; suture not well defined, being most distinct between the body and penultimate whorls. Base very slightly convexly rounded, thus giving rise to a somewhat abrupt convexity at the periphery of the body-whorl, most noticeable immediately above the mouth; the l [illegible] as it ap-

proaches the anterior end of the mouth is more distinctly and regularly convex, and as a consequence the periphery of the body-whorl becomes less abruptly convexly rounded towards the outer lip of the shell.

Apical angle about sixty degrees. Whorls consisting of an embryonic portion of about a whorl and a half, succeeded by six rapidly increasing very slightly convex whorls. No umbilicus. Aperture oval, columella solid, arched and strongly nacreous, outer lip thick internally and bevelled off to a thin outer edge.

Spirally ornamented with strong, raised, rounded ridges, increasing from about three or four posteriorly to six on the body-whorl, separated from one another by a furrow about equal in breadth to the ridges. Both ridges and furrows very finely spirally striate and crossed transversely by close-set oblique lines of growth; at an average distance of about one millimetre the lines of growth become raised into lamellæ, which give rise to prominent, raised, forwardly projecting scales where they cross the spiral ridges. Base similarly ornamented with nine prominent, spiral, scaly ridges, but with the scales more numerous and closer together, also both ridges and furrows closely and minutely spirally striate.

*Dimensions.*—Type specimen, length, 28 mm.: breadth, 26 mm; height of aperture, 8·5 mm.; breadth of aperture, 10 mm. Smaller specimen, height, about 25 mm.; breadth, 21 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania. Three examples.

*Observations.*—This species differs from the previously described species, *T. etheridgei*, T. Woods, from these beds, to such an extent in shape, general aspect and ornament that I think it superfluous to enter into any detailed differential characters, and therefore refer to the above description in the hope that it may be found sufficient for the identification of the species. I am not at present acquainted with any other living or fossil species sufficiently closely related to the present fossil form to require any special remarks. Specific name in compliment to Mr. E. D. Atkinson, by whom it was collected from the Table Cape beds.

ter T. Woods.

*T. alt* 1876, p. 97.

82. **Gibbula æquisulcata,** T. Woods.

*G. æquisulcata*, T. Woods, P.R.S.Tas., 1876, p. 98.

83. **Calliostoma tasmanica,** R. M. Johnston.

*Zizyphinus tasmanicus*, R. M. Johnston, P.R.S.Tas., 1879, p. 38.

84. **Calliostoma latecarina,** sp. nov. Plate III., figs. 10 and 11.

Shell small, trochiform, moderately thick, nacreous internally, strongly keeled at the periphery of the body-whorl, with a convex base below. Apical angle about sixty degrees. Apex small and somewhat obtuse, consisting of about one-and-a-half smooth, convex, embryonic whorls, the tip of which is central. The remainder of the shell consists of four somewhat flat to slightly convex and distinctly-shouldered whorls, the shouldering, owing to a marked flattening of the posterior slope in the neighbourhood of the suture, giving rise to the somewhat step-like appearance of the spire. The slope from the shoulder to the anterior suture on the spire-whorls usually only very slightly convex; on the body-whorl convex to the strong keel, which runs out towards the lower part of the outer lip. Below the keel the base is convex to the aperture. Aperture quadrate, outer lip broken but probably thin at its outer edge; inner lip nacreous, moderately thick, and reflected at the anterior end. Posterior slope between the shoulder and suture carries three fine spiral threads, the flat shallow interspaces between being about twice the width of the threads, and bearing about three much finer and just discernible spiral threads. Below the shoulder the interspaces become narrow and shallow spiral grooves, and the threads become broad and flat, about five or six of these strong threads on the spire-whorls, but on the body-whorl about three finer threads of the same character are noticeable on either side of the six stouter threads. By far the stoutest spiral band on the body-whorl is the keel, below which, that is on the base, there are eight or nine shallow spiral grooves, with broad flat ridges between, the latter tending to be subdivided into two anteriorly by the development of a finer groove along their middle.

*Dimensions.*—Length, 7 mm.; breadth, 6 mm.; breadth of aperture, 3 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania.

### 85. Delphinula imparigranosa, sp. nov. Plate III., figs. 8 and 9.

Shell small, turbinate, convex basally, with a well-elevated spire consisting of a few convex, coarsely granulose whorls, somewhat thick and strong, with a wide and deep umbilicus.

Apical angle about seventy degrees. Embryo obtuse and broad, being about two millimetres across, and consisting of about two whorls, the second of which is distinctly angulose close to the anterior suture, and carrying one spiral band of fine granules between the angulation and the suture. Spire consists of about three rapidly increasing convex whorls, with an ill-defined suture. Aperture comparatively large and round; outer lip thick internally, but thin at the extreme outer edge, and slightly effuse at the four points where the four strongest spiral ridges of granules of the body-whorl cease, much more strongly effuse at the posterior and anterior of the aperture; inner lip very thin and slightly reflected towards the umbilicus, regularly arched on the aperture side, slightly biangulated by the presence of two ridges on the umbilical side. Umbilicus very wide and deep, only about half a millimetre narrower than the aperture, and penetrating a considerable distance beyond the posterior canal, and strongly margined by an acutely-angular granulose ridge running round from the anterior canal and joining the aperture as the second ridge below the suture.

Surface ornamented with coarse and fine granulose spiral ridges, traversed by very fine transverse striæ parallel to the lines of growth. There are three strong unequal granulose ridges to each whorl, the posterior ridge being made up of the coarsest and as a consequence smallest number of granules; the succeeding or middle ridge carries closer, slightly smaller, and therefore a larger number of granules, whilst those on the anterior ridge are still finer and more numerous. On the body-whorl the strongest granules become almost angular nodulosities. Further, between these variously granulose ridges there is a still finer intercalated one, with one or two even finer spiral threads

on either side of it. On the convex base of the body-whorl there is a fourth granulose ridge slightly finer than the third, and situated midway between it and the one margining the umbilicus, and on either side of this ridge there are three spiral threads, the middle one being the strongest, though only faintly granulose. The whole surface finely obliquely striate, the striæ being parallel to the outer margin of the aperture or to the lines of growth. Umbilicus with two faint spirally-angulose ridges and a few obscure intercalated threads and fine striæ parallel to the inner lip.

*Dimensions.*—Length, 8 mm.; breadth, 8 mm.; breadth of aperture, 3 mm.; length from suture to end of anterior canal, 5 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania.

*Observations.*—At first I thought that this might possibly be *D. tetragonostoma*, T. Woods, but after careful consideration I have been unable to make it agree with the description of that species, the ornament particularly being markedly diverse from that expressed by the late Rev. J. E. T. Woods. The present species is, further, a much larger shell, though it is possible from the dimensions given of *D. tetragonostoma* that the latter species may have been founded on an immature shell. *D. tetragonostoma* is also stated to have some relation with the latticed Tasmanian *Liotias*, whereas the present form does not appear to me to show any such special resemblance.

### 86. Delphinula gibbuloides, T. Woods.

*Solarium* (*Torinia*) *gibbuloides*, T. Woods, P.R.S.Tas., 1876, pp. 97, 98.

Shell small, somewhat thick, broadly turbinate, somewhat depressed, with an obtuse apex, very large body-whorl, and a broad and deeply excavated umbilicus.

Apical angle about ninety degrees. Embryo obtuse, turbinate, consisting of about one-and-a-half smooth whorls, the second of which is slightly angulated. Spire-whorls three, flatly convex, with a deeply impressed suture between the earlier whorls, becoming less defined anteriorly. Body-whorl strongly keeled at the periphery, base convex to the well-elevated ridge margining the umbilicus. Aperture round; outer lip incomplete, smooth in-

ternally and probably thin at the outer edge; inner lip thin, slightly reflected towards the umbilicus and regularly concavely arched to the anterior canal, the latter being well-defined. Umbilicus very broad and deep, being a little broader than the aperture, and passing up more than half the height of the shell, strongly margined by a well-elevated ridge passing from the end of the anterior canal to a point a little below the suture of the body-whorl. Internally the umbilicus is finely striate and strongly angled by a revolving ridge, which starts from about the middle of the aperture, and a little higher up by another similar though very much fainter ridge.

Ornament consists first of the strong keel at the periphery of the body-whorl, but usually in juxtaposition to the anterior suture of the earlier whorls. This keel carries numerous erect, forwardly projecting spinose scales, which number about fifteen on the body-whorl. On the convex slope between the keel and the suture there are three unequally sized spiral bands of granules, the posterior band being made up of the coarsest granules. On the base between the keel and the thread margining the umbilicus is one prominent squamose spiral ridge with a much finer squamose thread on either side. Further, the shell is finely lamellosely-striate transversely.

*Dimensions.*—Length, 7 mm.; breadth, 8 mm.; breadth of aperture, 3 mm.

*Observations.*—After due consideration I have come to the conclusion that the shell I have described above is identical with that described by the late Rev. J. E. T. Woods under the name of *Solarium* (*Torinia*) *gibbuloides*, but as some of the features of the species have not already been very fully expressed, I take the opportunity of adding the above particulars in the hope that it may render its future identification less difficult. With regard to the generic location I prefer to place it under *Delphinula* as above, as its characters seem to point more clearly in that direction. In the original description it is stated that the shell is "conspicuously keeled, keel thin, finely granular, with irregular lines of rather larger granules above it." The herein-described form has very distinct forwardly-projecting scales on the keel and also on the succeeding ridge on the base, but not so prominent on the latter. These might, however, easily become worn or broken

off in such a manner as to leave the keel apparently granulose, and this may account for the above expression. In other respects I can see no difference between the original description and the form at present before me.

### 87. **Haliotis ovinoides**, McCoy.

*H. ovinoides*, McCoy, Prod. Pal. Vic., Dec. III., p. 24, pl. xxv., figs., 2, *2b*.

### 88. **Actæon puteolata**, sp. nov. Plate IV., figs. 10, 11 and 12.

Shell small, oval, with a heterostrophe embryo, prominent and acute spire, somewhat elongate body-whorl, comparatively large and entire aperture, with a strong tooth near the posterior end of the columella, and a faint umbilical chink. Apical angle about thirty degrees. Embryo rather small, consisting of about one-and-a-half smooth convex whorls enrolled in one plane in the heterostrophe portion, which are partially hidden by being immersed in the succeeding whorl. Heterostrophe portion of embryo followed by about another half whorl, which is smooth and convex, and completes the embryonic whorls. Spire-whorls three to four, regularly convex, with a well-defined and slightly channelled suture; whorls gradually increasing at first but comparatively suddenly expanding into the much larger and somewhat elongate body-whorl. Aperture oval, entire, very little less than half the length of the shell, somewhat effuse anteriorly. Outer lip smooth internally, with a thin margin, the slight sutural channelling being most noticeable at its junction with the body-whorl. Inner lip concavely arched, reflected outwardly towards the anterior end. Columella bearing one stout oblique tooth, which is situated rather high up, being immediately opposite the very small and narrow umbilical chink, or slightly above the middle of the aperture. Spire-whorls ornamented with about twelve comparatively broad and flat spiral threads, with very narrow and shallow intervening grooves. On the body-whorl the spiral threads become more numerous, amounting to about twenty, and at the same time become considerably broader bands, and tend to be faintly subdivided by very much fainter, narrower, and

shallower spiral striæ or grooves than the principal ones. In the principal grooves very fine and close striations parallel to the lines of growth are distinctly visible under a lens, and as they do not appear to cross the spiral threads or bands they give rise to the rather characteristic appearance of pitting along these grooves.

*Dimensions.*—Type example, length, 4·5 mm.; breadth, 2·25 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania.

*Observations.*—This species, which shows some relation to the shell previously described by the late Rev. J. E. T. Woods under the name of *Actæon scrobiculatus*, may possibly belong to the genus *Leucotina* of A. Adams, which was founded by that authority for the reception of living species in the Chinese and Japanese seas which are apparently of a somewhat similar type to our fossil form.

From *Actæon scrobiculatus* the present species may at once be separated, as it differs materially in shape and habit, having a relatively longer and more prominent spire, a more marked suture, shorter body-whorl, with one tooth-like plait towards the upper part of the columella instead of the strong obliquely twisted ridge towards the lower or anterior end of the aperture, and the distinct though small umbilicus.

### 89. **Cylichna woodsii**, Tate.

*C. arachis*, T. Woods (non Quoy and Gaimard), P.R.S.Tas., 1876, p. 102.

*C. woodsii*, Tate, P.R.S.Tas, 1884, pp. 211, 212 and 228.

### 90. **Tugalia crassireticulata**, sp. nov. Plate III., figs. 4 and 5.

Shell elongate oval, depressed patelliform, beak or umbo prominent and excentric posteriorly, situated at about one-third the length of the shell from the posterior margin. Greatest breadth (25 mm.) behind the beak across the middle line of the shell, narrowing much more rapidly anteriorly than posteriorly.

Margin coarsely denticulate, with a broad shallow sinus at the anterior end, otherwise almost perfectly flat; but close examination, when placed on a flat surface, shows a very slight lateral elevation, which is greatest at about the middle of each side, where it is very little more than about one millimetre.

Surface ornamented with coarse, gradually thickening ridges radiating in all directions from the umbo, alternate ridges slightly finer than the others, and with interspaces nearly as wide as the ridges. This ornament is crossed at distances of about one millimetre, or slightly less, by strong and regular concentric ridges, giving rise to a coarse reticulation over the whole surface. At the intersection of the radial and concentric ridging it is slightly nodulose when worn, but most likely somewhat squamose in the unworn condition.

*Dimensions.*—Antero-posterior diameter, 40 mm.; greatest breadth, 25 mm. at about 9 mm. in front of the umbo; height, 12 mm.; sinus, 5 mm. broad by about 1 mm. deep.

*Locality.*—Eocene beds of Table Cape, Tasmania. One example.

*Observations.*—This is the first species of this genus described from our Older Tertiary deposits, and it shows close relationship with the living *Tugalia parmophoidea*, Quoy and Gaimard, a not uncommon shell from the coasts of Tasmania, Victoria and South Australia. The present fossil species may however be distinguished from the living species, as it is of a different shape, being more regularly oval and its greatest breadth being anterior to the umbo; whereas the living species is broadest across or slightly posterior to the umbo, is proportionately broader and more suddenly rounded at the anterior end, and when placed on a flat surface the lateral margins are very much more highly and distinctly elevated. Further, the fossil species is much more coarsely ornamented and with coarser denticulations on the margin.

### 91. Entalis mantelli, Zittel.

*Dentalium kicksii*, McCoy, Woods, &c., see R . .
Cat. Aust. Foss., p. 163.

*Dentalium mantelli*, Zittel, Pal. von N
xiii., fig. 7, 1865.

*Entalis mantelli*, Tate, T.R.S.S.A., 1887, Scaphopoda, p. 190 (49 in Pamphlet).

92. **Dentalium lacteum**, Deshayes.

*D. lacteum*, T. Woods, P.R.S.Tas., 1874, p. 17.

*D. lacteum*, Tate, T.R.S.S.A., 1887 [1886], Scaphopoda, p. 193 (52 in Pamphlet).

## LAMELLIBRANCHIATA.

93. **Ostrea**, sp.

*Observations.*—The specimens before me are not sufficiently well preserved, nor do they show sufficient characters to enable me to refer them to any definite specific name.

94. **Placunanomia sella**, Tate.

*P. sella*, Tate, Lam. I., 1886, p. 102, pl. v., figs. 1*a* to 1*c*.

95. **Pecten yahlensis**, T. Woods.

*P. yahlensis*, T. Woods, Trans. Phil. Soc. S.A., 1865, pl. i., fig. 4.

*P. yahlensis*, var. *semilævis*, McCoy, Prod. Pal. Vic., Dec. IV., pp. 13, 14, pl. xxxiv.

*P. yahlensis*, Tate, Lam. I., 1886, p. 110.

96. **Pecten hochstetteri**, Zittel.

*P. hochstetteri*, Zittel, Pal. von Neu-Seeland, p. 50, pl. xi., figs. 5*a* and 5*c* (non 5*b*, fide Tate), 1864.

*P. pleuronectes*, T. Woods (non Gmelin), Trans. Phil. Soc. S.A., 1865, pl. i., fig. 5.

*P. hochstetteri*, Hutton, Cat. Tert. Foss. N.Z., p. 30, 1873.

*P. hochstetteri*, Tate, Lam. I., 1886, p. 114.

97. **Pecten foulcheri**, T. Woods.

*Pecten*, sp., Sturt, Two Expeditions, p. 254, pl. iii., fig. 14.

*P. foulcheri*, T. Woods, Trans. Phil. Soc. S.A., 1865, pl. i., fig. 3.

*P. foulcheri*, Tate, Lam. I., 1886, p. 111.

### 98. Lima bassii, T. Woods.

*L. bassii*, T. Woods, P.R.S.Tas., 1876, p. 112.

*L. bassii*, Tate, Lam. I., 1886, p. 117, pl. v., fig. 8, and pl. viii., fig. 1.

### 99. Limatula jeffreysiana, Tate.

*Lima* (*Limatula*) *subauriculata*, T. Woods, (non Montfort), P.R.S.Tas., 1876, p. 113.

*Lima jeffreysiana*, Tate, P.R.S.Tas., 1884, pp. 213 and 230.

*Lima* (*Limatula*) *jeffreysiana*, Tate, Lam. I., 1886, p. 119, pl. iv., fig. 8.

### 100. Spondylus gæderopoides, McCoy.

*S. gæderopoides*, McCoy, Prod. Pal. Vic., Dec. IV., 1876, pp. 27, 28, pl. xxxviii., Dec. V., pl. xlv., figs. 1, 3.

*S. gæderopoides*, Tate, Lam. I., 1886, p. 121.

### 101. Nucula tenisoni, nom. mut.

*Nucula tumida*, T. Woods (non Hinds, non Phillipi), P.R.S.Tas., 1876, p. 111.

*Nucula grayi*, T. Woods (non D'Orbigny), P.R.S.Tas., 1877, p. 55.

*Nucula tumida*, Tate, Lam. I., 1886, p. 127, pl. vi., figs. 6*a*, 6*b*.

*Observations*.—I regret that I am at present unable to give as thorough an account of this species as I should like, but failing completeness the following are the facts that have been made out :—*Nucula grayi*, D'Orbigny, was recorded as a living Tasmanian shell by the late Rev. J. E. T. Woods in 1877, when he gave the following very brief description :—" Ovate, very transverse, acuminate at both ends, thin, inflated, very smooth, olive and shining. Very rare. Long Bay. Rev. H. D. Atkinson." This description seems to me to have an uncommonly Leda-like aspect and does not at all indicate to my mind a shell of the type of that now living in Port Phillip Bay, to which apparently, unfortunately, the name of *N. grayi* has become attached.

The original description as given by D'Orbigny in 1846 is as follows :—" N. testa ovali subtrigona lævigata crassa compressa, epidermide fuscoviridescenti ; latere buccali brevi, truncato,

complanato; latere anali elongato subangulato. Longeur dix millimetres." I cannot regard this as identical with the shell described by Tenison Woods. I am also unable to make Sowerby's description of *N. grayi*, given in Reeve's Conchologia Iconica, fit our living species. The description given is as follows:—"Shell ovate, very transverse, slightly acuminated at both ends, thin, rather inflated, very smooth, olive; posterior side produced; dorsal area compressed, elevated sub-aliform, end acuminated; anterior side a little produced, cuneated; lunule short, defined." Recorded from South America by D'Orbigny and from New Zealand on the authority of Cuming. The Nucula at present living in Port Philip Bay is not at all uncommon when dredging about the neighbourhood of Brighton or Mordialloc. On several occasions living specimens have been obtained as well as numerous single valves. Having made very careful comparisons between this living species and our very common eocene and miocene, and, according to Professor Tate, also older pliocene fossil, I am forced to the conclusion that there is not the slightest difference between them worthy of the name, and I have therefore no hesitation whatever in again upholding their identity. A fact worthy of note, in my opinion, is that the Spring Creek fossils are those which show the most marked divergence from the living form, whereas those from the eocene beds of Muddy Creek and Mornington, which belong to a higher horizon in the series, according to the opinion held by Mr. T. S. Hall and myself, are absolutely identical, as is also the case with the miocene fossil, though it is noticeable that the latter reached somewhat larger dimensions than those hitherto obtained in the living state. The fossil form was first examined by the Rev J. E. T. Woods in 1876, when he described it as a new species under the name of *N. tumida*, remarking that it was "not unlike the Tasmanian *N. grayi*, Sow., but more tumid and conspicuously sulcate." Subsequently Professor Tate, when dealing with the Tertiary Lamellibranchs, accepted Tenison Woods' species and agreed with him as to its differences from the living Tasmanian species. Both the Rev. J. E. T. Woods and Professor Tate have, however, overlooked the fact that the name *Nucula tumida* had already been preoccupied by Mr. Hinds for a living shell obtained

whilst dredging in the Straits of Malacca.* So that under the circumstances it would hardly be wise to retain the name *N. tumida* for our fossil, as the living shell under that name is a very distinct species. Now, whatever may be the right name to apply to our living Nucula, I have very grave doubts about its identification with *N. grayi*, D'Orb., being correct, and I have up to the present been entirely unable to satisfy myself as to what it should be. Our fossil form, in my opinion, must participate in the same name as the living form, and as vagueness and uncertainty surrounds the latter, and as the former is obviously in want of a name, the simplest way out of the difficulty for the present, though perhaps not the wisest, is to propose for our common fossil, figured and described in the above quoted works, the new name of *Nucula tenisoni*, the specific name attached being a tribute to the late Rev. J. E. T. Woods, whose researches in Australian Tertiary Palæontology are well known to all colonial geologists.

### 102. **Leda crebrecostata**, T. Woods.

*L. crebrecostata*, T. Woods, P.R.S.Tas., 1876, p. 112.

*Nuculana crebrecostata*, R. Etheridge, jun., Cat. Aust. Foss., 1878, p. 155.

*L. crebrecostata*, Tate, Lam. I., 1886, p. 133, pl. v., figs. 5*a*, 5*b*.

### 103. **Pectunculus cainozoicus**, T. Woods.

*Cucullæa cainozoica*, T. Woods, P.R.S.Tas, 1876, p. 111.

*Pectunculus cainozoicus*, Tate, Lam. I., 1886, p. 136, pl. x., figs., 8*a*, 8*b*.

*Id.*, R. M. Johnston, Geo. Tas., 1888, pl. xxxi., figs. 13, 13*a*, 13*b*.

### 104. **Pectunculus laticostatus**, Quoy and Gaimard.

*P. laticostatus*, Quoy and Gaimard, Voy. de l'Astrol., vol. iii., p. 466, pl. lxxvii., figs. 4–6, 1835.

*P. laticostatus*, McCoy, Prod. Pal. Vic., Dec. II., 1875, p. 26, pl. xix., figs. 10–14.

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*P.Z.S., 1843, p. 98, and Voy. H.M.S. "Sulphur," Mollusca, 1844, p. 63, pl. xviii., fig. 6.

*P. maccoyii*, R. M. Johnston, P.R.S.Tas., 1884, p. 199, and Geo. Tas., 1888, p. 235, pl. xxxi., figs. 1–1*d*.

*P. laticostatus*, Tate, Lam. I., 1886. p. 137.

*P. maccoyii*, Tate, *loc. cit.*

### 105. Cucullæa corioensis, McCoy.

*C. corioensis*, McCoy, Prod. Pal. Vic., Dec. III., 1876, p. 32, pl. xxvii., figs. 3–5*b*.

*C. corioensis*, Tate, Lam. I., 1886, p. 144.

*C. coriensis*, R. M. Johnston, Geo. Tas., 1888, p. 235, pl. xxix., figs. 4, 4*a*.

### 106. Trigonia semiundulata, McCoy.

*T. semiundulata*, McCoy, Geo. Mag., vol. iii., .p. 481, and Prod. Pal. Vic., Dec. II., 1875, p. 22, pl. xix., figs. 4, 5.

*T. semiundulata*, Tate, Lam. I., 1886, p. 145.

*T. semiundulata*, R. M. Johnston, Geo. Tas., 1888, p. 235, pl. xxix., fig. 5.

### 107. Crassatella oblonga, T. Woods.

*C. oblonga*, T. Woods, P.R.S.Tas., 1875, p. 25, pl. ii., fig. 11.

*C. oblonga*, R. M. Johnston, Geo. Tas., p. 234, pl. xxix., figs. 1, 1*a*.

*Observations.*—This species is also recorded by Professor Tate as occurring in the miocene beds at Muddy Creek, Victoria, and in the oyster beds of the North-west Bend, River Murray. My examination of the Table Cape specimens enables me, however, to assert positively that the Muddy Creek shells are very distinct indeed, and the differences are such that to my mind they necesitate the description and renaming of the Victorian species, which I hope to undertake in my next palæontological paper.

### 108. Crassatella aphrodina, T. Woods.

*C. aphrodina*, T. Woods, P.R.S.Tas, 1875, p. 24, pl. iii., fig. 12.

*C. aphrodina*, Tate, Lam. I., 1886, p. 147.

*C. aphrodina*, R. M. Johnston, Geo. Tas., p. 234, pl. xxix., fig. 2.

*Observations.*—There is only one specimen among the Crassatellas before me which seems to correspond with the figures and

descriptions as referred to above, and in the absence of sufficient material I am unable to speak very definitely, but am somewhat inclined to think that this is hardly a valid species, and that it may prove to be but a varietal form of *C. oblonga*, T. Woods.

### 109. **Mytilicardia platycostata**, R. M. Johnston.

*M. platycostata*, R. M. Johnston, P.R.S.Tas., 1879, p. 40.
*M. platycostata*, Tate, Lam. I., 1886, p. 150.

### 110. **Cardita gracilicostata**, T. Woods.

*C. gracilicostata*, T. Woods, P.R.S Tas., 1876, p. 112.
*C. gracilicostata*, Tate, Lam. I., 1886, p. 152, pl. ii., figs. 6, 8.

*Observations.*—This species was recorded by Mr. J. Dennant in 1888 as occurring in the older beds at Muddy Creek, Victoria [T.R.S.S.A, vol. xi., 1888, p. 50]; subsequently Mr. T. S. Hall and I recorded it in our paper on the Older Tertiaries of the Southern Portion of the Moorabool Valley [P.R.S.Vic, vol. iv., n.s.], the identification being made for us by Mr. Dennant. Upon looking up the Moorabool Valley specimens so-named, I find that they were wrongly identified, and ought to have been regarded as *C. polynema.* In view of this I cannot but feel some doubt about the Muddy Creek record, which should, I think, be further confirmed or else withdrawn from the lists. It is satisfactory, however, that I am now in a position to record the occurrence of typical examples of *C. gracilicostata* from the eocene beds at Birregurra, whence it was obtained in material kindly forwarded to my friend Mr. T. S. Hall by Mr. Alex. Purnell. Having before me undoubted examples of the species from Table Cape, its type locality, and having made careful comparisons to the minutest detail between these and the Birregurra shell, I have no hesitation whatever in giving this as the only Victorian locality as yet known to me.

### 111. **Cardita scabrosa**, Tate.

*Id.*, Tate, Lam. I., 1886, p. 152, pl. ii., fig. 4.

*Observations.*—The validity of this species is, I think, a matter of extreme doubt, and further investigation may prove that it is but a small form of *C. gracilicostata*, T. Woods. My attention

was drawn to this shell by the fact that a Table Cape specimen had been so named in the collection of the Ballarat School of Mines, and upon examination I found it to be identical with a form in the Atkinson collection which I had regarded merely as a young and well-preserved example of *C. gracilicostata*. Further, upon going over the descriptions and figures of these two species given by Professor Tate, their extreme closeness, if not absolute identity, seems to be apparent.

### 112. **Cardita tasmanica**, Tate.

*Id.*, Tate, Lam. I., 1886, p. 154, pl. xii., fig. 13.

### 113. **Lucina planatella**, Tate.

*Id.*, Tate, P.R.S.Tas., 1884, p. 229, and T.R.S.S.A., 1886, pl. xii., fig. 11, and Lam. II., p. 146.

### 114. **Diplodonta subquadrata**, Tate.

*Id.*, Tate, Lam. II., 1887, p. 147, pl. xiv., figs. 10*a*, 10*b*.
*Id.*, R. M. Johnston, Geo. Tas., p. 234, pl. xxxii., figs. 14, 14*a*.

### 115. **Chama lamellifera**, T. Woods.

*Id.*, T. Woods, P.R.S.Tas., 1876, p. 114.
*Id.*, Tate, Lam. II., 1887, p. 149, pl. xiv., fig. 5*a*, 5*b*.

*Observations.*—Tenison Woods, in giving the dimensions of this species, says :—" Largest specimens about lat. 24 by 22 and 18 mm. thick." Professor Tate states that they rarely exceed twenty millimetres of diameter. Several examples in the present collection do not conform to these dimensions, and a special feature of the majority is the extreme thickening of the shell. There are six examples above the dimensions given by Tenison Woods, ranging for their antero-posterior diameter from 25 mm. to 38 mm., and giving an average of a little over 30·5 mm., for their dorso-ventral diameter from 22 mm. to 29 mm., or an average of 25 mm., and in the thickness of the shell they run from 2 mm. to 8 mm.

### 116. **Chamostrea albida**, Lamarck.

*C. albida*, Lamarck, Anim. Sans. Vert., vol. vi., p. 96, 1819.
*C. crassa*, Tate, P.R.S.Tas., 1884, p. 228.

*C. albida*, Tate, Lam. II., 1887, p. 149.

*Observations.*—A single left valve of this species has been already recorded from the eocene beds of Table Cape on the authority of Professor Tate, founded upon a specimen collected by Mr. R. M. Johnston. There is a single right valve in the present collection, the state of which gives rise to an element of doubt, and suggests the possibility that it may have accidentally become entangled in some of the detritus of the shore line. Upon questioning Mr. Atkinson as to where this shell was collected, he said that he could not be certain that it was obtained *in situ*, and thought that it might probably have been included from beach material. I shall be very glad to receive any further information which may tend to prove or disprove with certainty the occurrence of this species as a fossil in these beds. Additional colour is lent to this doubt by the presence in the collection of the shelly tube of a marine worm, a living species, evidently included among the fossils accidentally, for it is still in a very fresh condition, despite a certain amount of erosion suffered on the beach. Also by the record by Mr. R. M. Johnston of *Arca trapezia*, Deshayes, as a Table Cape fossil, subsequently, however, expunged from the list.

### 117. Cardium septuagenarium, Tate.

*Id.*, Tate, Lam. II., 1887, p. 151.

*Id.*, R. M. Johnston, Geo. Tas., p. 234, pl. xxxii., figs. 1, 15 and 16.

### 118. Chione allporti, T. Woods.

*Venus allporti*, T. Woods, P.R.S.Tas., 1875, p. 26, pl. iii., fig. 10.

*Chione allporti*, Tate, Lam. II., 1887, p. 154.

*Venus allporti*, R. M. Johnston, Geo. Tas., p. 234, pl. xxxii., figs. 2 and 3.

### 119. Chione multilamellata, Tate.

*Id.*, Tate, Lam. II., 1887, p. 154.

### 120. Chione hormophora, Tate.

*C.* (*Timoclea*) *hormophora*, Tate, P.R.S.Tas., 1884, p. 230, and Lam. II., 1887, p. 155, pl. xv., figs. 1*a*–1*b*.

### 121. **Chione cainozoica**, T. Woods.

*C. cainozoica*, T. Woods, P.R.S.Tas., 1876, p. 113.

*C. cainozoica*, Tate, Lam. II., 1887, p. 156, pl. xvi., figs. 3*a*–3*b*.

*C. cainozoica*, R. M. Johnston, Geo. Tas., p. 233, pl. xxxii., figs. 8, 8*a*, 11 and 11*a*.

### 122. **Chione propinqua**, T. Woods.

*C. propinqua*, T. Woods, P.R.S.Tas., 1876, p. 113.

*Observations.*—The specimens attributed to Tenison Woods' species by Professor Tate as occurring in the "lower and upper beds at Muddy Creek, but common in the latter only," do not in my opinion belong to the same species as the Table Cape specimens, and on that account the Victorian fossil, which is a very characteristic miocene form, stands in need of a name. In order to clear up the confusion surrounding this species I intend, in my next paper, to redescribe and rename the Victorian miocene fossil, with full particulars as to the points wherein it differs from the Table Cape species.

### 123. **Cytherea tenuis**, Tate.

*C. tenuis*, Tate, Lam. II., 1887, p. 159, pl. xiv., fig. 16.

*C. eburnea* ?, Johnston (non Tate), Geo. Tas., p. 233, pl. xxxii., figs. 9, 9*a*.

*Observations.*—The shell recorded and figured by Mr. R. M. Johnston as *Cytherea eburnea*, Tate, does not appear to be Professor Tate's species, but may probably represent *C. tenuis*, Tate.

### 124. **Dosinia densilineata**, sp. nov. Pl. IV., figs. 5, 6 and 7.

Shell orbicular, thin to thick, varying from about ·5 mm. or less in young shells to 3 mm. in thickness in the adult form; fairly convex, most marked in the umbonal region, maximum convexity situated about one-third the length of the umbo-ventral diameter from the dorsal margin in about the middle line of the shell. Umbones well defined, regularly convexly incurved obliquely towards the anterior end, from which they are situated about one-third the length of the shell.

Lunule elongate cordate, deeply depressed, finely and closely lamellose. The shell immediately anterior to the umbo and in

the neighbourhood of the lunule is markedly concave to a little beyond the lower end of the lunule, thence the anterior margin is regularly convex and protruding well forward before joining the convex ventral margin; post-dorsally flat on the dorsal surface, but the margin is slightly convexly rounded to meet the ventral margin with which it forms a very obtuse angle.

Externally the valves are ornamented with very numerous close-set concentric ridges, which are flat medially, but on account of being set somewhat obliquely appear slightly acutely elevated towards the umbo, becoming distinctly lamellose anteriorly and posteriorly, the lamellæ being directed towards the ventral margin and being most highly elevated along the posterior and anterior slopes of the valve. The concentric ridges become slightly broader towards the ventral margin, the intervening grooves are comparatively shallow and very much narrower than the ridges, usually considerably less than one-half their width, and becoming broader as the ridges become lamellose. The number of concentric ridges in more than half a dozen specimens of about the same dimensions as *Dosinia johnstoni*, Tate, namely, 29 mm. by 27 mm., average forty-nine in ten millimetres from the ventral margin; in specimens of larger dimensions they become gradually less in number, and in the largest specimen yet to hand, which measures 62 mm. by 57 mm., we have only eighteen concentric ridges.

Both ridges and grooves very finely, regularly, and closely concentrically striate, the striæ of the grooves becoming distinctly lamellose ventrally and laterally, usually more distinct at the posterior end. Internally the hinge is thick and strong in the adult form, with a well-defined and deep ligamental area post-dorsally; the hinge of the right valve bearing three strong cardinal teeth, the middle one being slightly bifid, whilst the posterior one is more distinctly so; there are also two rudimentary anterior lateral teeth at the base of the lunular area; the left valve also carries three strong cardinal teeth, the middle one only being slightly bifid, and one strong anterior lateral tooth. The pallial sinus is very broad at the base and deeply protruding into the shell horizontally and vertically beyond the centre of the valve, apex usually convexly rounded, occasionally acutely angular.

*Dimensions.*—Average dimensions of the Table Cape specimens: Antero-posterior diameter, 29 mm.; umbo-ventral diameter, 27 mm.; thickness through both valves, 15 mm.

Average dimensions of Spring Creek specimens:—Antero-posterior diameter, 50 mm.; umbo-ventral diameter, 45 mm.; thickness through single valve, 12·5 mm.

The largest specimen yet to hand is from the Spring Creek beds, which gives the following measurements:—Antero-posterior diameter, 62 mm.; umbo-ventral diameter, 57 mm.; thickness through the single valve, 15 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania. Seven double valves and a single valve. Common in the lower eocene sandy beds of Spring Creek, near Geelong, and the lower beds of Maude, Moorabool Valley; also from the eocene limestone at Waurn Ponds (McCann's Quarry).

*Observations.*—This species is obviously closely related to *Dosinia johnstoni*, Tate, better proof of which we could not have than the fact that Professor Tate himself has recorded this very characteristic miocene species as occurring in the eocene beds of Table Cape and Spring Creek. The eocene and miocene shells seem to me however to be sufficiently distinct, after long and minute study, to warrant the description and the application of a new name to the eocene form.

In the first place, an important difference between the herein-described species and *D. johnstoni*, Tate, and one which the most casual observer can hardly fail to detect at first sight, is the very much closer, finer, and even more regular concentric ridging. In Professor Tate's description of *D. johnstoni* he states that the concentric ridges are "separated by linear deep sulci (about twenty in a breadth of ten millimetres measured from the ventral margin)." As the Table Cape shells are not very far removed in dimensions from those given by Professor Tate for *D. johnstoni*, they will serve as a reliable basis upon which the contrast of the concentric ornamentation may be indicated. These Tasmanian examples give an average of forty-nine grooves in the 10 mm. from the ventral margin as against the above. In the examination of the Table Cape examples a noticeable feature is that as the specimens increase in dimensions the concentric ridges tend to become slightly less in number. This latter feature

is still further brought out, and to a much more marked degree, by the larger shells from Spring Creek, thus in the largest specimens (62 mm. by 57 mm.) yet to hand from this locality we have only eighteen concentric ridges in the ten millimetres from the ventral margin. In addition, the lunule of *D. densilineata* is larger, longer and more depressed, the umbo is more markedly incurved and very much more inflated, and situated further back from the anterior margin. Viewed from the dorsal margin the outline is much more convex medially and flatter laterally. These characters seem to me ample to distinguish this shell as a good species. During the study of this species I have not neglected to compare it with many actual examples of living species of the genus. In the National Museum, Melbourne, there are upwards of forty species of Dosinia, which, through the kindness of Mr. W. Kershaw, I have had an opportunity of examining, and I take occasion now to tender him my best thanks. Of the living species hitherto examined, that which seems to me closest related to *D. densilineata*, particularly the larger Spring Creek representatives, is *D. lamellata*, Reeve, from North Australia, but our fossil species differs from this mainly in that the antero-posterior diameter is proportionately longer, and that the anterior and posterior slopes are flatter, these characters giving a very different aspect to the shell. Further, the lunule of *D. densilineata* is much longer and somewhat flatter, though about the same breadth, the umbo is more inflated, and the concentric ridging is stouter in the umbonal region and not finely lamellose as in the recent species; medially the ornament is somewhat similar in both the fossil and recent species, consisting of flat concentric ridges becoming distinctly lamellose laterally, also lamellosely ornamented near the ventral margin, but the intervening grooves are shallower in the fossil shell. Mr. T. S. Hall and I have also recorded this species as *D. johnstoni* from the eocene beds of Maude, and I now take this opportunity of correcting that record. In view of the above it should now stand as *D. densilineata*. A further point worthy of note in a Tasmanian representative of this species lent me by the Ballarat School of Mines is that when somewhat slightly decorticated exceedingly fine, close, and regular radial riblets are rendered visible. I have also been able to determine with certainty this

feature in some of the Victorian shells, but owing to their good state of preservation it is rarely noticeable; on the other hand, even with worn and decorticated examples of *D. johnstoni*, I have hitherto been entirely unable to detect anything of this kind in that species. The type of this species is in my own collection.

### 125. Tellina cainozoica, T. Woods.

*Id.*, T. Woods, P.R.S.Tas., 1876, p. 113.
*Id.*, Tate, Lam. II., 1887, p. 164, pl. xviii., fig. 5.

### 126. Zenatiopsis fragilis, sp. nov. Plate IV., figs. 3 and 4.

Shell very thin and fragile, elongate oblong, much depressed, anterior end very short, posterior end much elongated.

Dorsal margin straight or slightly concave, anterior margin regularly convex to about the anterior extremity, still convex but more gradually so to meet the ventral margin, which is straight or slightly convex and parallel to the dorsal margin from a point slightly posterior to a line passing through the umbo for a distance slightly in excess of half the full length of the shell, thence the margin has a more gradual slope up to the posterior extremity than at the anterior end, thence more rapidly convex to join the dorsal margin. Anterior gape commences immediately anterior to the umbos, while the posterior gape commences slightly posterior to the umbos, the ventral margins of the valves being in contact. Valves very slightly convex, greatest convexity situated at the intersection of the antero-posterior diameter and a line perpendicular to it and passing through its middle point; from this point the convex slope is more marked dorsally than ventrally and only just appreciable anteriorly and posteriorly. Umbo, though small, is prominent, acute and incurved, and situated about one-sixth the length of the shell from the anterior extremity. Surface ornamented with numerous shallow concentric corrugations of the shape above indicated, and fine, close-set, concentric striations, with a few very faint radial striations from the umbo posteriorly.

*Dimensions.*—Type, antero-posterior diameter, 33 mm.; dorso-ventral diameter, 12 mm.; thickness through both valves, 4 mm. Largest specimen yet to hand measures 46 mm. by 17 mm., with a thickness through both valves of 7 mm.

*Locality.*—Eocene beds of Table Cape, Tasmania. Two double valves and a right valve.

*Observations.*—This species has been confounded by Mr. R. M. Johnston (Geo. Tas., p. 233) and Professor Tate (Lam. II., 1887, p. 172) with *Zenatiopsis angustata*, Tate, from which however it may be distinguished by its much greater delicacy, its different shape, straight or concave dorsal margin, parallel ventral margin, and the absence of the general posterior attenuation present in that species.

### 127. **Myodora australis**, R. M. Johnston.

*Id.*, R. M. Johnston, P.R.S.Tas., 1879, p. 40.

*Id.*, Tate, Lam. II., 1887, pp. 174, 175, pl. xvii., figs. 10*a*, 10*b*.

### 128. **Myodora brevis**, Sowerby.

*Pandora brevis*, Sowerby, App. to Stutchbury's Sale Cat., p. 3, fig. 2.

*Myodora brevis*, E. A. Smith, Voy. Chall. Zoo., vol. xiii., 1885, Lamellibranchs, p. 64.

*Myodora æquilateralis*, R. M. Johnston, P.R.S.Tas., 1879, p. 40.

*Myodora æquilateralis*, Tate, Lam. II., 1887, p. 176, pl. xvii., fig. 8.

### 129. **Corbula ephamilla**, Tate.

*C. sulcata*, McCoy (non Lamarck), A.M.N.H., 1866, and Exhibition Essay, 1866, p. 19.

*C. sulcata*, T. Woods (non Lamarck), P.R.S.Tas., 1874, p. 16.

*C. ephamilla*, Tate, P.R.S.Tas, 1884, pp. 213 and 229; also Lam. II., 1887, p. 176, pl. xvii., figs. 13*a*–13*c* and 14.

*Observations.*—Sir Frederick McCoy states of this species:—"The only other excessively common living species of shell in our miocene or oligocene beds is the *Corbula sulcata*, Lam., of the tropical seas of the west coast of Africa, whence I have procured living specimens, so that, as in the other cases of identity of species spoken of, I might not run the chance of misleading my readers by erroneous identifications based on comparisons with figures or descriptions only." Professor Tate, however, in the face of this very clear decision, says, when naming and describing our fossil, he has "no means of ascer-

certaing what amount of reliance is to be placed on McCoy's determination."

In the National Museum, Melbourne, there are six specimens labelled *Corbula sulcata*, Lam., from the west coast of Africa, which are most likely to be the specimens above mentioned by Sir F. McCoy. Through the kindness of Mr. W. Kershaw, of the Museum, I have been enabled to examine these specimens closely and compare them critically with actual examples of our fossil species, and I have no hesitation in expressing that in my opinion our common and widely ranging fossil is specifically distinct from *C. sulcata*, Lam., and therefore, as far as the present investigation goes, *C. ephamilla*, Tate, should stand for our fossil.

### 130. **Panopæa agnewi**, T. Woods.

*Lyonsia agnewi*, T. Woods, P.R.S.Tas., 1875, p. 25, fig. 13.
*Panopæa agnewi*, Tate, Lam. II., 1887, p. 179.

### 131. **Solecurtus legrandi**, T. Woods.

*S. legrandi*, T. Woods, P.R.S.Tas., 1875, p. 25, fig. 14.
*S. legrandi*, Tate, Lam. II., 1887, p. 181, pl. xvii., fig. 15.
*S. legrandi*, R. M. Johnston, Geo. Tas., p. 233, pl. xxxii., fig. 18.

## BRACHIOPODA.

### 132. **Waldheimia grandis**, T. Woods.

*W. grandis*, T. Woods, Trans. Phil. Soc. S.A., 1865, pl. ii., fig. 1.
*W. gambierensis*, R. Etheridge, jun., A.M.N.H., 1876, vol. xvii., p. 19, pl. ii., fig. 4.
*W. grandis*, Tate, Trans. Phil. Soc. S.A., 1880, p. 13, pl. xi., figs. 3 and 4.

### 133. **Waldheimia garibaldiana**, Davidson.

*Terebratula*, sp., Sturt, Two Expeditions in S.A., vol. ii., pl. iii., fig. 15, 1834.
*Terebratula compta*, T. Woods (non Sowerby), Geo. Obs. in S.A., p. 74, wdct., 1862.

*Waldheimia garibaldiana*, Davidson, Geologist, vol. v., p. 466, pl. xxiv., fig. 9, 1862.

*Waldheimia imbricata*, T. Woods, Trans. Phil. Soc. S.A., 1865, fig. 3, and P.R.S.N.S.W., 1878, p. 79, fig 1.

*Waldheimia garibaldiana*, R. Etheridge, jun., A.M.N.H., vol. xvii., p. 17, pl. i., fig. 2, 1876.

*Waldheimia macropora*, McCoy, Prod. Pal. Vic., Dec. V., pl. xliii., figs 4 and 6.

*Waldheimia garibaldiana*, Tate, Trans. Phil. Soc. S.A., 1880, p. 7, pl. xi., figs. 1*a*–1*c*.

*Waldheimia garibaldiana*, Johnston, Geo. Tas., p. 232, pl. xxxiii., fig. 13.

### 134. **Terebratula vitreoides**, T. Woods.

*T. vitreoides*, T. Woods, P.R.S.N.S.W., 1878, p. 78, figs. 4*a*–4*d*.

*T. vitreoides*, Tate, Trans. Phil. Soc. S.A., 1880, p. 5, pl. viii., figs. 5*a*, 5*b*, and pl. x., figs. 7*a*, 7*b*.

*T. vitreoides*, Johnston, Geo. Tas., p. 232, pl. xxxii., fig. 14.

### 135. **Terebratulina scoulari**, Tate.

*T. scoulari*, Tate, Trans. Phil. Soc. S.A., 1880, p. 19, pl. viii., figs. 3*a*–3*d*.

*T. scoulari*, Johnston, Geo. Tas., p. 232, pl. xxxiii., fig. 2.

### 136. **Terebratella tepperi**, Tate.

*T. tepperi*, Tate, Trans. Phil. Soc. S.A., 1880, p. 21, pl. ix., figs. 8*a*–8*c*.

*T. tepperi*, Johnston, Geo. Tas., p. 232, pl. xxxiii., fig. 6.

### 137. **Magasella compta**, Sowerby.

*Terebratella compta*, Sowerby, in Strezlecki's Phys. Desc. of N.S.W., etc., 1845, p. 297, pl. xix., fig. 4.

*Terebratella compta*, T. Woods, Trans. Phil. Soc. S.A., 1865, fig. 4, *a*—*e*.

*Terebratella compta*, R. Etheridge, jun., A.M.N.H., 1876, p. 19, pl. ii., fig. 5.

*Magasella compta*, Tate, Trans. Phil. Soc. S.A., 1880, p. 23, pl. x., figs. 6*a*–6*e*.

*Magasella woodsiana*, Tate, *op. cit.*, pp. 24, 25, pl. x., figs. 3*a*–3*d*.

*Observations.*—This is a somewhat variable species, and after examining 162 specimens from various localities I cannot see that any useful purpose is served in retaining *M. woodsiana* as specifically distinct from the other forms, as there are so many gradations between them that it becomes a matter of impossibility to separate them into two distinct species.

### 138. **Rhynchonella squamosa**, Hutton.

*R. squamosa*, Hutton, Cat. Tert. Moll. N.Z., p. 37, 1873.

*R. lucida*, McCoy, etc., non. Gould, see R. Etheridge, jun., Cat. Austr. Foss., 1878, p. 151.

*R. squamosa*, Tate, Trans. Phil. Soc. S.A., 1880, p. 27, pl ix., figs. 9*a*, 9*b*, also Trans. Roy. Soc. S.A., 1885, p. 94.

*R. squamosa*, Johnston, Geo. Tas., p. 233, pl. xxxiii., fig. 12.

## ECHINODERMATA.

### 139. **Conoclypeus rostratus**, Tate.

*C. rostratus*, Tate, P.R.S.N.S.W., 1893, p. 194, pl. xiii., fig. 1.

### 140. **Lovenia forbesi**, Woods and Duncan.

Var. *woodsi*, R. Etheridge, jun.

*Spatangus hoffmanni*, Sturt (non Goldfuss), Two Exped. in S.A., 1834, pl. iii., fig. 10.

*Spatangus*, sp., Forbes, "Lectures on Gold," etc., London, D. Bogue, 1852.

*Spatangus forbesi*, McCoy, M.S.

*Hemipatagus forbesi*, McCoy, M.S.

*Spatangus forbesi*, T. Woods, Geo. Obs. in S.A., 1862, p. 75, woodcut.

*Hemipatagus forbesi*, Woods and Duncan, A.M.N.H., 1864, ser. 3, vol. xiv., p. 165, pl. vi., fig. 3, *e–f*.

*Hemipatagus forbesi*, Laube, Akad. d. Wiss. Wien, 1869, vol. lix., p. 193, figs. 4–4*b*.

*Hemipatagus woodsi*, R. Etheridge, jun., Q.J.G.S., 1875, vol. xxxi., p. 445, pl. xxi., figs. 1, 7.

*Hemipatagus woodsii*, Johnston, P.R.S.Tas., 1876, p. 116.

*Lovenia forbesi*, Woods and Duncan, Q.J.G.S., 1877, vol. xxxiii., p. 56, pl. iv., figs. 5 to 8.

*Lovenia forbesi*, McCoy, Prod. Pal. Vic., Dec. VI., 1879, pp. 37–40, pl. lx., figs. 1–4.

*Sarsella forbesi*, Pomel, Theses par A. Pomel, Class. method. Ech. viv. et foss., Alger, 1883, p. 28.

*Lovenia forbesi*, Woods and Duncan, Q.J.G.S., 1887, vol. xliii., pp. 424 to 426.

*Observations.*—This very common echinoid has given rise to more controversy and difference of opinion than any other of the Australian Tertiary Echinoids, and as a consequence there is still a great amount of confusion existing as to its correct generic position, and as to the rightful author of the specific name. With regard to the latter nothing could be more clearly expressed than Professor P. M. Duncan's views on the subject in 1887, where it is distinctly shown that Woods and Duncan should be regarded as the authors of the species, Professor Duncan himself including T. Woods' name on account of the assistance rendered to him by the latter when describing the species. Sir F. McCoy states "that it is impossible to divide this species into two as suggested by Mr. Etheridge, jun. (*L. woodsi* and *L. forbesi*), from the number of primary tubercles in the posterior lateral interambulacra, although I notice that those with the more numerous tubercles are more common in the Murray Cliffs and more rare near Melbourne, and that they are less pentagonal from a slightly greater proportional length and less protuberant sides, and have the apex usually farther from the posterior end and the posterior ridge stronger." The form of this species occurring at Table Cape comes in the same group as the specimens from the River Murray Cliffs.

### 141. Cyclaster archeri, T. Woods.

*Echinolampas*, sp., T. Woods, Geo. Obs. in S.A., 1862, p. 77, woodcut.

*Hemiaster archeri*, T. Woods, Trans. Phil. Soc. S.A., 1867, figs. 2*a*–2*d*.

*Micraster brevistella*, Laube, Akad. d. Wiss. Wien, 1869, vol. lix., p. 192, fig. 8

*Micraster brevistella*, R. Etheridge, jun., Q.J.G.S., 1875, vol. xxxi., p. 447, figs. 11 and 12.

*Micraster brevistella*, Johnston, P.R.S.Tas., 1876, p. 116.

*Brissopsis archeri*, Tate, T.R.S.S.A., 1884, p. 41.

*Micraster archeri*, Tate, T.R.S.S.A., 1891, p. 277.

*Cyclaster lycoperdon*, Bittner, Akad. d. Wiss. Wien, 1892, p. 360, pl. iv., figs. 1, 2.

? *Cyclaster morgani*, Cotteau (*fide* Tate).

## ZOANTHARIA.

142. **Flabellum distinctum**, Edwards and Haime.

143. **Placotrochus deltoideus**, Duncan.

144. **Deltocyathus italicus**, Edwards and Haime.

List of species recorded from Table Cape in addition to the foregoing. Those marked with an asterisk seem to me to require confirmation, and those marked † I have seen from the Ballarat School of Mines Museum.

## CEPHALOPODA.

1. Aturia australis, McCoy.

## GASTROPODA.

†2. Murex camplytropis, Tate.
3. Murex legrandi, Johnston.
4. Triton crassicostatus, Tate.
5. Epidromus tasmanicus, Johnston (Triton).
6. Fusus craspedotus, Tate.
7. Fusus dictyotis, Tate.
*8. Buccinum fragile, T. Woods.
*9. Voluta allporti, Johnston.
*10. Voluta agnewi, Johnston.
*11. Voluta hannafordi, McCoy (V. alticostata, Tate, may have been mistaken for this species).
*12. Voluta macroptera, McCoy.
13. Marginella octoplicata, T. Woods.
14. Marginella wentworthi, T. Woods.

15. Marginella micula, Tate, var.
†16. Ancillaria hebera, Hutton.
17. Columbella cainozoica, T. Woods.
18. Columbella oxleyi, T. Woods.
19. Cancellaria etheridgei, Johnston.
20. Terebra simplex, T. Woods.
21. Bela pulchra, Tate.
22. Pleurotoma pullulascens, T. Woods.
23. Pleurotoma sanderloides, T. Woods.
24. Mangelia gracilirata, T. Woods.
†25. Borsonia marginata, T. Woods (Thala).
*26. Cypræa eximia, G. B. Sowerby.
27. Trivia avellanoides, McCoy (syn., T. europæa, T. Woods, &c., non Montfort, T. minima, T. Woods).
28. Erato minor ?, Tate.
29. Erato duplicata, Johnston.
30. Crepidula hainsworthi, Johnston.
31. Calyptropsis umbilicata, Johnston, sp. (syn., Crepidula umbilicata, Johnston).
32. Crossea sublabiata, Tate (syn., Crossea labiata, T. Woods).
33. Scalaria (Acrilla) inornata, Tate.
34. Turritella tristira, Tate.
35. Turritella acricula, Tate.
36. Thylacodes conohelix, T. Woods (Vermetus).
37. Leiostraca johnstoniana, Tate (syn., Eulimella subulata, T. Woods, non Donovan).
38. Turbonilla pagoda, T. Woods.
39. Turbonilla liræcostata, T. Woods.
40. Odostomia microlirata, Johnston (syn., Syrnola bifasciata, T. Woods).
41. Mathilda transenna, T. Woods (Turritella).
42. Pyramidella roberti, T. Woods.
43. Pyramidella sulcata, Johnston.
44. Pyramidella polita, Johnston.
45. Rissoa stevensiana, T. Woods.
46. Rissoina varicifera, T. Woods.
47. Rissoina johnstoni, T. Woods.
48. Rissoina tateana, T. Woods.

49. Liotia roblini, Johnston (syn., Liotia discoidea, T. Woods, non Reeve).

50. Adeorbis lævis, Johnston.

51. Gibbula crassigranosa, T. Woods.

52. Gibbula clarkei, T. Woods.

53. Cantharidus ? josephi, T. Woods (Trochus).

54. Eumargarita keckwicki, T. Woods (Margarita).

55. Calliostoma blaxlandi, T. Woods (Zizyphinus).

56. Calliostoma atomus, Johnston (Zizyphinus).

57. Euchelus woodsii, Johnston.

58. Delphinula tetragonostoma, T. Woods.

59. Megatebennus malleata, Tate (Fissurellidæa), (syn., Fissurella concatenata, T. Woods, non Crosse).

60. Emarginula transenna, T. Woods.

61. Actæon scrobiculata, T. Woods.

62. Ringicula lactea, Johnston.

## LAMELLIBRANCHIATA.

63. Pecten polymorphoides, Zittel.

64. Pecten lucens, Tate.

65. Pecten (Amusium) zitteli, Hutton (syn., Amusium atkinsoni, Johnston).

66. Limea transenna ?, Tate (syn., ? Cucullæa minuta, Johnston).

*67. Spondylus pseudoradula ?, McCoy.

68. Crenella globularis, Tate.

69. Nucula atkinsoni, Johnston (Portlandia).

70. Nucula fenestralis, Tate.

71. Leda huttoni, T. Woods.

72. Leda prælonga, Tate.

73. Leda apiculata, Tate.

*74. Limopsis aurita, Brocchi (probably L. insolita, Sow.).

75. Limopsis belcheri, Adams and Reeve.

76. Arca pseudonavicularis, Tate.

77. Barbatia celleporacea, Tate.

78. Trigonia tubulifera, Tate.

79. Crassatella communis, Tate (syn., C. astartiformis, Tate).

80. Carditella lamellata, Tate.

*81. Cardita trigonalis, Tate.
82. Cardium pseudomagnum, McCoy.
83. Chione dimorphophylla, Tate.
84. Cytherea eburnea, Tate.
*85. Psammobia hamiltonensis, Tate.
86. Psammobia æqualis, Tate.
87. Phragmorisma anatinæformis, Tate.
88. Aspergillum, sp.

## BRACHIOPODA.

89. Waldheimia furcata, Tate.
90. Waldheimia johnstoniana, Tate.
91. Waldheimia corioensis, McCoy.
92. Waldheimia pectoralis ?, Tate.
93. Waldheimia tateana, T. Woods.
94. Waldheimia taylori, R. Etheridge, jun.
95. Terebratulina lenticularis, Tate.
96. Terebratulina triangularis, Tate.
97. Terebratulina davidsoni, R. Etheridge, jun.
98. Terebratella woodsii, Tate.

## ZOANTHARIA.

99. Flabellum duncani, T. Woods.
100. Flabellum gambieriense, Duncan (syn., ? F. pedicellare, Tate).
101. Flabellum victoriæ, Duncan.
102. Placotrochus elongatus ?, Duncan.
103. Notocyathus excisus, Duncan (Sphenotrochus).
104. Notocyathus viola, Duncan (Caryophyllia).
105. Conotrochus maccoyi, Duncan.
106. Heliastræa tasmaniensis, Duncan.
107. Antillia lens, Duncan.
108. Thamnastræa sera, Duncan.
109. Thamnastræa tasmaniensis, Duncan ?.
110. Palæoseris woodsi, Duncan (Trochoseris)
111. Balanophyllia australiensis, Duncan.
112. Dendrophyllia duncani, T. Woods.
113. Dendrophyllia epitheca, T. Woods.
114. Astrangia tabulosa, Tate.

P.S.—The Geological Survey of Victoria subdivided the Spring Creek beds, near Geelong, into three, and applied the terms Lower, Middle, and Upper Miocene to these subdivisions. The examinations of this section made by Mr. T. S. Hall and myself enable us to recognise at present only two distinct palæontological zones, and we are of the same opinion as Messrs. Tate and Dennant that the Survey's so-called upper beds cannot be separated from their middle beds. I draw attention to the above in order that there may be no misinterpretation of the earlier portion of this paper, where I have referred to the so-called middle beds at Spring Creek and their probable equivalents, the clay beds of this portion of the section at Spring Creek having yielded a very fair collection of gastropods and lamellibranchs, which has very materially assisted in determining its equivalents elsewhere.

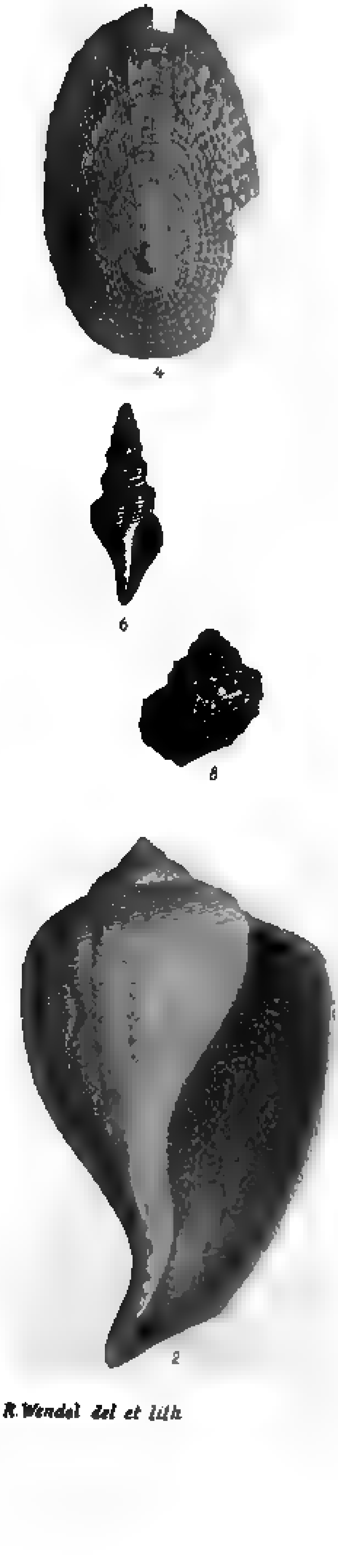
## EXPLANATION OF PLATES.

### Plate II.

Fig. 1.—Voluta halli, sp. nov., adult specimen, natural size.
„ 2.—Voluta halli, young example, natural size.
„ 3.—Voluta halli, embryonic whorls of an unusually tumid young example, natural size.
„ 4.—Peristernia murrayana, var. costata, nov., natural size.
„ 5.—Latirofusus cingulata, sp. nov., twice natural size.
„ 6.—Latirofusus cingulata, enlarged ornament.
„ 7.—Trophon selwyni, sp. nov., natural size.
„ 8.—Lyria semiacuticostata, sp. nov., natural size.
„ 9.—Terebra prægracilicostata, sp. nov., twice natural size.
„ 10.—Peristernia semiundulata, sp. nov., natural size.
„ 11.—Peristernia semiundulata, enlarged ornament.
„ 12.—Pleurotoma wynyardensis, sp. nov., natural size.
„ 13.—Pleurotoma wynyardensis, enlarged ornament.

### Plate III.

Fig. 1.—Voluta atkinsoni, sp. nov., adult specimen, natural size.
„ 2.—Pyrula altispira, sp. nov., front view, natural size.

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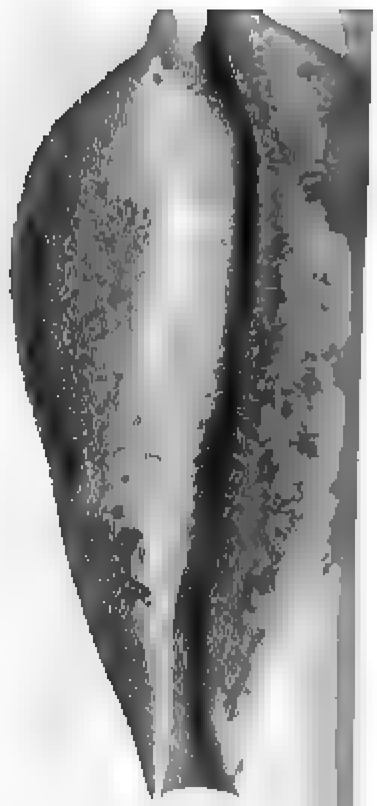
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# ART. VIII.—*Remarks on the Proposed Subdivision of the Eocene Rocks of Victoria.*

By T. S. HALL, M.A.

(Demonstrator and Assistant Lecturer in Biology in the University of Melbourne),

And G. B. PRITCHARD

(Lecturer in Geology in the Working Men's College, Melbourne).

[Read December 12th, 1895.]

Last year we contributed a paper to this Society in which, when discussing the older tertiary rocks of Maude, (1) we indicated what we believed to have been the general order of succession of the eocene rocks of Victoria. During the present year a paper by Professor Ralph Tate and Mr. J. Dennant (2) has appeared, in which our conclusions are objected to and a number of arguments are brought forward in opposition to them. The number and variety of the interpretations of the succession of the rocks in question already advanced show the difficulty of the subject, and an historical account of the various views held has been given by one of us elsewhere (3).

Before considering the objections of Messrs. Tate and Dennant it will be better perhaps to state briefly the steps by which we arrived at our conclusions. For a fuller statement of the case reference must be made to our former article (1). We recognised three horizons, characterised by differences in their fauna, and as types of these horizons we took those deposits which had been most fully elaborated, namely, Lower Muddy Creek, Waurn Ponds, and Spring Creek. We found that where the "Muddy Creek" and "Waurn Ponds types" occurred together, the latter was the underlying deposit, and that beds of the "Waurn Ponds type" in several places overlay the older volcanic rock. At Maude we found that the latter rock was underlain by a series of beds which, on palæontological grounds, we correlated with the Spring Creek beds. As a further confirmation of our view we calculated the percentage of recorded living species in the

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Muddy Creek and in the Spring Creek beds and found the result to point in the same direction, namely, that the Spring Creek beds are older than those of Muddy Creek.

The force of some of the objections raised to our views by Messrs. Tate and Dennant, especially as regards the value of the polyzoal rock as a bench mark, cannot be gainsaid, but there are others which we are not at all prepared to allow. We are still of opinion that the Spring Creek series is older than the Muddy Creek one, and that the older volcanic rock is older than the Muddy Creek beds and younger than part, at any rate, of the Spring Creek series.

As a matter of convenience we shall consider Messrs. Tate and Dennant's objections in the order in which they appear in their paper.

In the first place (2, p. 116) the following sentence occurs in their paper :—"At Maude, as is well known, tertiary deposits occur both above and below a layer of basalt, which has been described by the survey as a subsequent intercalation, but this reading is disputed in the article referred to," that is, in our paper. From this passage it would, we think, naturally be concluded that the volcanic rock of this section was regarded by the officers of the survey as of more recent date than the marine beds with which it is intercalated, and that it was in opposition to their views that we regarded it as contemporaneous. In other words, it was open to doubt if it really represented the older volcanic, and that any conclusions we might draw from our view of the case were to be received with caution. But the word "subsequent" does not appear, as far as we can find, in any of the references to the section. As a matter of fact our views on this point are in complete accord with those of the survey, and it was by means of this very section that the age of the older volcanic rock was determined by Selwyn for the colony generally. What we did differ from the survey on was a very minor point. The officers state in effect that after the main flow of basalt, of about 100 feet in thickness, a period of quiescence followed, during which a thin bed of limestone was deposited. Then a thin sheet of basalt was poured out, covering the limestone and metamorphosing it, and that then the deposition of limestone and other marine beds was resumed. We hold that there is only one

sheet of basalt, and that the intercalated limestone does not exist, the appearances being due to deposition as a littoral deposit on a bouldery basalt bottom. It is evident that on the main question, the age of the volcanic rock, we are in agreement with the survey in considering it the "older basalt."

The authors then say that we placed the Spring Creek section lower than the Muddy Creek beds and some others "from its slightly lower percentage of recent species." This is however only a partial statement of our reasons for so doing. Our main reason was stratigraphical, and it was by the latter means that we arrived at our conclusion in the first place, and we took the percentage as a piece of confirmatory evidence.

In calculating our percentage for Muddy Creek we stated that "at least ten recent species are now known from these beds" (1, p. 191). Messrs. Tate and Dennant (2, p. 116) say that eight and not ten are "recorded to have living representatives." It is quite possible that the authors are not prepared to accept as correct all the recent species which are recorded from the lower beds at Muddy Creek. We went carefully through the literature once more, and find that our statement was below the mark; we should have said not ten but eleven. Of these nine are to be found recorded, both as occurring in the lower beds and as being recent species, by Messrs. Tate and Dennant. The tenth has been recorded as occurring by them and has been recorded as recent by us, while the eleventh was recorded from Muddy Creek by one of us, and is an acknowledged recent species.

We are not aware that any of these records have been publicly withdrawn or contradicted, and we give the list with some of the references.

RECORDED LIVING SPECIES IN THE LOWER BEDS OF MUDDY CREEK.

| | Record in Lower Beds of Muddy Creek. | Record living. |
|---|---|---|
| Crepidula unguiformis, Lamk. | 4. p. 330 | 4. p. 330 |
| Capulus danieli, Crosse | 4. p. 334 | 4. p. 334 |
| Hipponyx antiquatus, Linn. | 4. p. 329 | 4. p. 329 |
| Dentalium lacteum, Deshayes | 5. p. 52<br>6. p. 223 | 5. p. 52 |

| | Record in Lower Beds of Muddy Creek. | Record living. |
|---|---|---|
| Ostræa hyotis, Linn. - - - | 7. p. 49 - | 7. p. 53 |
| Placunanomia ione, Gray - - | 9. p. 20 - | 8. p. 9 |
| Pectunculus laticostatus, Q. & G. | 10. p. 16 - | 8. p. 44 |
| Nucula tenisoni, Pritchard - - | as *N. tumida* 6. p. 224 10. p. 16 | as *N. grayi* 1. p. 190 |
| Limopsis aurita, Brocchi - - | 7. p. 50 - | 8. p. 41 |
| Limopsis belcheri, Ad. & R. - | 7. p. 50 - | 8. p. 41 |
| Saxicava arctica, Linn. - - | 2. p. 113 - | 5. p. 38 |

On the following page of the Correlation Paper (p. 17) Messrs. Tate and Dennant state that the number of species passing up from the eocene of Muddy Creek and of Spring Creek into younger deposits is distinctly opposed to our view of the succession. As in the last instance, however, we must take exception to the figures on which they base their calculations. They state that thirty species from Muddy Creek and sixteen from Spring Creek pass up into the miocene. Taking the published papers of Messrs. Tate and Dennant as our authorities, and counting the species recorded as miocene, or in a few cases as younger, and which also occur in the eocene beds, we find our results are widely different from those just quoted. The number of mollusca recorded as passing up from the eocene of Muddy Creek into younger deposits is not thirty but seventy-two, and in the case of Spring Creek, not sixteen but thirty-nine. These records, however, require revision, as although some of the genera have been critically examined since some of the records were made, still the probably incorrect ones have not been expunged, and some species have been recorded with doubt, owing to the imperfect condition of the specimens. In the case of two of the Spring Creek records, namely, *Chione propinqua* and *Dosinia johnstoni*, one of us has elsewhere given reasons for considering them as distinct from the miocene species, and has renamed them. When we reject the species which, after carefully considering the matter, we think should be omitted on the grounds above stated, we obtain for Muddy Creek sixty-eight, and for Spring Creek thirty-three. We are, however, met by a fresh difficulty, and that is what is the total number of molluscan species hitherto obtained

from the two localities. Messrs. Tate and Dennant say they have 649 from Muddy Creek. We believe that we have 326 from the lower beds at Spring Creek. Basing our calculations on these figures, we get about 10 per cent. passing up at Spring Creek and about 10·5 at Muddy Creek, a result which is of little value one way or the other.

We must admit that we were incorrect in grouping together the polyzoal limestones we mentioned in our paper, and that they properly should be associated with the molluscan beds and worked out by their aid. The echinoderms, brachiopods, and pectens, which constitute the bulk of the larger fossils they contain, are practically the same in the beds we specified. But when, as at Upper Maude, we have gastropods and lamellibranchs other than pectens associated with them, we are, as pointed out by Messrs. Tate and Dennant, on surer ground. Last Easter we were fortunate in finding a block of limestone in the quarry *débris* at Waurn Ponds, which contained, amongst other forms, lamellibranch casts similar to those we recorded from North Belmont, and which induced us to place the latter deposit on the same horizon as Spring Creek. Upon the evidence of the brachiopods, echinoderms and pectens we associated the Upper Maude beds with those of Waurn Ponds, but at the same time mentioned that the gastropods from the Clyde section really corresponded with those from calcareous clays overlying and interbedded with the polyzoal limestone at Batesford, and it is consequently with the latter and not with the Waurn Ponds series that the Upper Maude beds should be associated. The Batesford limestones are, it will be remembered, in turn overlain by the richly fossiliferous clays of the Southern Moorabool valley (13).

As a correct reading of the Spring Creek section has an important bearing on the whole question, we may briefly restate the opinions that have been held on the subject. Daintree, who had charge of the survey party in the district, at first recognised two divisions in the beds, the upper comprising everything as far down as the hard band, which we identify as that forming the top of Bird Rock. He distinguished them in his report as Upper and Lower Miocene (11). A short time afterwards the coralline or polyzoal limestone, which he regarded as passing over the top of the clays and sands, was separated from the lower beds, and a

triple series was thus distinguished, which was stated to show sufficient palæontological differences to justify the application of the names Upper, Middle, and Lower Miocene (12).

Subsequently Messrs. Tate and Dennant stated (6) that the polyzoal limestone merged into the upper series of clays, sands, and hard limestone bands, and that no palæontological distinction other than that caused by change of sediment existed. In their last paper (2) they have admitted that there are two zones at Spring Creek, but still refer the whole of the series to one epoch, namely, eocene.

The result of our examination of the section is to confirm the observations of Messrs. Tate and Dennant on these three points. Consequently, instead of the three subdivisions of the survey, we have only two, as their two upper divisions merge laterally.

Hitherto most of the collecting has been done in the lower zone, with the exception of echinoderms, brachiopods and a few pectens, which have been gathered from the polyzoal limestone, and from what Messrs. Tate and Dennant term the echinoderm rock. The molluscan lists and the calculations deduced from them have been founded on the material contained in the beds at or about the level of those of Bird Rock.

On our last two visits to Spring Creek we carefully searched the beds above the echinoderm rock at Fisherman's Steps and along the accessible portions of the cliffs towards Rocky Point, where similar beds overlie the limestones. As already pointed out by Messrs. Tate and Dennant, the most interesting point about the beds is the occurrence of a large percentage of forms not hitherto recorded from the section. Many of these are new, others have only been recorded from Table Cape, while some are common species at others of our eocene sections, which we have grouped with Lower Muddy Creek. It is these last that are specially of interest in considering the question of the general sequence of the Victorian beds. If the Spring Creek series occupied an intermediate position between the Lower Muddy Creek series and the miocene, we should expect the fauna of the higher of the two zones at Spring Creek to be still more closely allied to the miocene, and less so to that of the Lower Muddy Creek series than is that of the lower zone.

This, however, is not the case. The forms that now appear for the first time, or are common instead of rare as in the lower zone, are typical eocene species, which are common at such beds as Mornington. From this horizon we note eleven species recorded for the first time from Spring Creek section, which are common at Mornington, and four which, though previously recorded for the lower beds, are uncommon or even rare, while occurring frequently in what we regard as higher beds elsewhere.

A recent visit to Maude has enabled us to increase our list of species from the lower beds, and the decided affinity of the fauna to that of Spring Creek will be seen on examination of the table showing the occurrence of the fossils at Spring Creek, Muddy Creek, and Mornington.

TABLE SHOWING THE OCCURRENCE OF LOWER MAUDE FOSSILS AT OTHER LOCALITIES.

| Lower Maude Fossils, with Corrections and Additions. | Spring Creek. | Lower Muddy Creek. | Mornington. |
|---|---|---|---|
| *Zoantharia.* | | | |
| Placotrochus elongatus, Dunc. - - | X | X | X |
| Notocyathus australis, Dunc. - - - | X | X | X |
| „ excisus, Dunc. - - - | X | X | X |
| Deltocyathus italicus, Ed. and H. - - | X | X | - |
| (to replace Bathyactis discus) | | | |
| *Echinodermata.* | | | |
| Eupatagus rotundus, Dunc. - - - | X | - | - |
| (to replace Maretia anomala) | | | |
| Monostychia sp. - - - - | - | - | - |
| Fibularia gregata, Tate - - - | X | - | - |
| Fibularia n. sp. (?) - - - - | - | - | - |
| Scutellina patella, Tate - - - | X | X | X |
| *Annelida.* | | | |
| Serpula, sp. - - - - - - | - | - | - |
| *Brachiopoda.* | | | |
| Magasella compta, Sow. - - - | X | X | - |
| Terebratulina scoulari, Tate - - - | X | X | X |
| Rhynchonella squamosa, Hutton - - | - | X | - |
| Crania, sp. - - - - - - | - | - | - |

| Lower Maude Fossils, with Corrections and Additions. | Spring Creek. | Lower Muddy Creek. | Mornington. |
|---|---|---|---|
| *Crustacea.* | | | |
| ? Lepas, sp. | X | - | - |
| *Lamellibranchiata.* | | | |
| Ostræa, sp. | - | - | - |
| Dimya dissimilis, Tate | X | X | X |
| Pecten consobrinus, Tate, var. | X | - | - |
| „ foulcheri, T. Wds. | X | X | X |
| „ eyrei, Tate | X | - | - |
| Hinnites corioensis, McCoy | - | X | - |
| Spondylus gæderopoides, McCoy | X | - | - |
| Limopsis insolita, Sow. | X | - | - |
| „ belcheri, Ad. and R. | X | X | X |
| Pectunculus cainozoicus, T. Wds. | X | X | - |
| Cucullæa corioensis, McCoy | X | X | X |
| Trigonia tatei, Pritchard | - | - | - |
| Cardita maudensis, Pritchard | - | - | - |
| Carditella, n. sp. | X | - | - |
| Cardium pseudomagnum, McCoy | X | - | - |
| Lucina leucomomorpha, Tate | X | X | - |
| Dosinia densilineata, Pritchard | X | - | - |
| Mactra, n. sp. | - | - | - |
| Diplodonta, n. sp. | - | - | - |
| Chama lamellifera, T. Wds. | X | X | X |
| Myadora tenuilirata, Tate | X | X | X |
| Corbula ephamilla, Tate | X | X | X |
| „ pyxidata, Tate | X | - | X |
| *Gastropoda.* | | | |
| Turritella conspicabilis, Tate | X | - | - |
| „ gemmulata, Tate | X | X | - |
| „ sp. | X | - | - |
| Mathilda transenna, T. Wds. | X | X | - |
| Natica wintlei, T. Wds. | X | - | - |
| Tenagodes occlusus, T. Wds. | X | X | X |
| Odostomia, sp. | - | - | - |
| Rissoina, sp. | - | - | - |
| Tinostoma, sp. | - | - | - |
| Solariella, sp. | - | - | - |
| Cylichna exigua, T. Wds. | X | X | - |
| „ sp. | X | - | - |
| Scutus, n. sp. | - | - | - |
| *Scaphopoda.* | | | |
| Entalis subfissura, Tate | X | X | X |
| *Pisces.* | | | |
| Otoliths | - | - | - |

Of the thirty-seven species of Mollusca enumerated, twenty-six are described; of these, twenty-three occur at Spring Creek, fifteen at Muddy Creek, and ten at Mornington, while three additional undescribed species occur at Spring Creek, and do not, as far as we are aware, occur at either Muddy Creek or Mornington.

Additions and corrections to the list of species from Waurn Ponds (1, p. 184) :—

Notocyathus australis, Dunc.
Deltocyathus italicus, Ed. and H.
Eupatagus murrayensis, Laube, instead of E. murrayanus.
Eupatagus rotundus, Dunc.
Cassidulus florescens, Gregory, instead of Echinobrissus, n. sp.
Terebratulina lenticularis, Tate.
Terebratulina davidsoni, R. Eth., jun.
Placunanomia sella, Tate, instead of P. ione, Gray.
Pecten consobrinus, Tate, var., instead of P. subbifrons, Tate.
Pecten eyrei, Tate, instead of n. sp.
Pecten peroni, Tate.
Hinnites corioensis, McCoy.
Limatula jeffreysiana, Tate.
Nucula tenisoni ?, Pritchard.
Leda apiculata, Tate.
Pectunculus cainozoicus, T. Wds.
Trigonia semiundulata, McCoy.
Cardita polynema ?, Tate.
Chione halli, Pritchard.
Chione cainozoica, T. Wds.
Dosinia densilineata, Pritchard.
Mactra howchiniana, Tate.
Natica wintlei ?, T. Wds.
Turritella conspicabilis ?, Tate.
Voluta halli, Pritchard.
Entalis mantelli, Zittel.
Pleurotoma, sp.

This brings the Waurn Ponds list up to seventy-two species.

Revised and extended list of fossils from the limestone of Batesford (see 13, p. 18) :—

Placotrochus deltoideus, Dunc.

Placotrochus elongatus, Dunc.
Flabellum gambierense, Dunc.
Isis, sp.
Chelæ of crustacea.
Cidaroid plates and spines.
*Psammechinus woodsii, Laube.
Scutellina patella, Tate.
Clypeaster gippslandicus, McCoy.
Monostychia australis, Laube.
Pericosmus gigas, McCoy.
Pericosmus, sp.
Waldheimia garibaldiana, Davidson.
*Waldheimia divaricata, Tate.
*Waldheimia macleani, Tate.
Waldheimia furcata, Tate.
Terebratula vitreoides, T. Wds.
Terebratulina davidsoni, R. Eth., jun.
*Terebratulina scoulari, Tate.
Magasella compta, Sow.
Rhynchonella squamosa, Hutton.
*Crania quadrangularis, Tate.
Ostræa, sp.
Pecten murrayanus, Tate.
Pecten polymorphoides, Zittel.
Pecten consobrinus, Tate, var. replaces P. subbifrons, Tate.
Pecten, sp.
Limatula jeffreysiana, Tate.
Spondylus pseudoradula, McCoy.
Septifer fenestratus, Tate.
Pectunculus cainozoicus, T. Wds.
Nucula, sp.
Dosinia densilineata, Pritchard.
Mactra howchiniana, Tate.
Tenagodes, sp.
*Patella, n. sp.
Casts of trochoid shells.
Lamna, sp.
*Vertebral epiphyses, probably of a whale.

Those marked by an asterisk were collected by Mr. J. Mulder.

List of Fossils from the clay bed in the upper part of the Batesford limestone:—

Placotrochus deltoideus, Dunc.
Placotrochus elongatus, Dunc.
Flabellum gambierense, Dunc.
Notocyathus excisus, Dunc.
Notocyathus viola, Dunc.
Notocyathus australis, Dunc.
Deltocyathus italicus, Ed. and H.
Rhynchonella squamosa, Hutton.
Crania, n. sp.
Limopsis belcheri, Ad. and R.
Limopsis aurita, Brocchi.
Cucullæa corioensis, McCoy.
Crassatella dennanti, Tate.
Cardita delicatula, Tate.
Corbula ephamilla, Tate.
Typhis laciniatus, Tate.
Murex lophoessus, Tate.
Murex velificus, Tate.
Murex asperulus, Tate.
Ricinula purpuroides, Johnston.
Ranella prattii, T. Wds.
Triton woodsii, Tate.
Nassa tatei, T. Wds.
Voluta hannafordi, McCoy.
Mitra othone, T. Wds.
Marginella propinqua, Tate.
Marginella micula, Tate.
Ancillaria semilævis, T. Wds.
Genotia angustifrons, Tate.
Pleurotomidæ, five species.
Conus acrotholoides, Tate.
Conus extenuatus, Tate.
Conus dennanti, Tate.
Trivia avellanoides, McCoy.
Cassidaria gradata, Tate.
Natica polita, T. Wds.

Natica hamiltonensis, T. Wds.
Natica substolida, Tate.
Natica (Sigaretopsis) subinfundibulum, Tate.
Turritella platyspira, T. Wds.
Thylacodes conohelix, T. Wds.
Eulima danæ, T. Wds.
Cerithium crebarioides, T. Wds.
Astralium johnstoni ?, Pritchard.
Trochidæ, 7 species.
Entalis subfissura, Tate.
Entalis mantelli, Zittel.

### Limestone Fossils from Spring Creek.

Those marked with an asterisk were obtained from the limestones near the mouth of Spring Creek only; those without any indicating mark from the limestone at Rocky Point and its continuation to Fisherman's Steps. Those with a dagger are common to both limestones.

Graphularia senescens, Tate.
Holaster australiæ, Duncan.
Eupatagus laubei, Dunc.
,, rotundus, Dunc.
†Lovenia forbesii, Woods and Dunc.
Cassidulus florescens, Gregory.
Monostychia australis, Laube.
Fibularia gregata, Tate.
†Scutellina patella, Tate.
*Echinobrissus vincentianus, Tate.
†Cyclaster archeri, T. Wds.
*Linthia ? sp.
Psammechinus woodsi, Laube.
Paradoxechinus novus, Laube.
Antedon, sp.
*Waldheimia divaricata, Tate.
,, insolita, Tate.
†Magasella compta, G. B. Sow.
†Terebratulina davidsoni, R. Eth., jun.
†Terebratella woodsi, Tate.

Anomia, sp.
Dimya sigillata, Tate.
*Pecten foulcheri, T. Wds.
„ polymorphoides, Zittel.
„ n. sp.? aff. eyrei.
Limatula crebresquamata, Tate m.s.
*Patella, n. sp.
Gastropod casts at Rocky Point.

### Fossils from the Upper Clays at Spring Creek.

Those marked with an asterisk are common at Mornington and other similar beds, but not hitherto recorded from the lower zone at Spring Creek. Those marked with a dagger are common in the upper zone and at Mornington, etc., but though recorded from the lower zone are far from common.

Placotrochus deltoideus, Dunc.
Flabellum distinctum, Ed. and H.
Flabellum duncani, T. Wds.
Flabellum, sp.
Bathyactis discus, T. Wds.
Graphularia senescens, Tate.
Waldheimia insolita, Tate.
Waldheimia divaricata, Tate.
Dimya dissimilis, Tate.
Dimya sigillata, Tate.
Pecten hochstetteri, Zittel.
Pecten murrayanus, Tate.
Pecten foulcheri, T. Wds.
Pecten consobrinus, Tate, var.
Pecten eyrei, Tate.
Pecten peroni, Tate.
Limatula crebresquamata, Tate, m.s.
Spondylus gæderopoides, McCoy.
*Spondylus pseudoradula, McCoy.
Modiola, sp.
Nucula tenisoni, Pritchard.
Nucula atkinsoni, Johnston.
Leda crebrecostata, T. Wds.

Leda apiculata, Tate.
Leda, n. sp.
Limopsis insolita, G. B. Sow.
Limopsis belcheri, Ad. and R.
Limopsis multiradiata, Tate.
Pectunculus cainozoicus, T. Wds.
Pectunculus laticostatus, Q. and G.
Fossularca, n. sp.
Cucullæa corioensis, McCoy.
Trigonia semiundulata, McCoy.
Crassatella halli, Tate m.s.
Cardita polynema, Tate.
Cardita delicatula, Tate.
Cardita, n. sp.
Carditella lamellata, ? Tate.
†Chama lamellifera, T. Wds.
Cardium pseudomagnum, McCoy.
*Cardium antisemigranulatum, McCoy.
Chione halli, Pritchard.
Chione pritchardi, Tate, m.s.
Chione cainozoica, T. Wds.
Chione, sp.
Dosinia densilineata, Pritchard.
Myochama trapezia, Pritchard.
†Corbula ephamilla, Tate.
Corbula pyxidata, Tate.
Solecurtus ellipticus, Tate.
*Typhis evaricosus, Tate.
Typhis maccoyi, T. Wds.
Muricidea, sp.
Triton tortirostris, Tate.
Ricinula purpuroides, Johnston.
Latirofusus, sp.
Clavella, n. sp.
Peristernia semiundulata, Pritchard.
Voluta anticingulata, McCoy, var. persulcata.
Voluta halli, Pritchard.
Voluta stephensi, Johnston.
*Mitra othone, T. Wds.

Mitra, n. spp., 2.
Marginella propinqua, Tate.
*Marginella micula, Tate.
Oliva adelaidæ, Tate.
Ancillaria pseudaustralis, Tate.
*Ancillaria hebera, Hutton.
Ancillaria ligata, Tate.
Ancillaria, sp. n.
*Columbella clathrata, Tate, m.s.
Columbella, n. sp.
Cancellaria etheridgei, Johnston.
Pleurotoma paracantha, T. Wds.
Pleurotoma, n. spp., 2.
Genotia fontinalis, Tate.
Raphitoma columbelloides, T. Wds.
Borsonia, sp. n.
Pleurotomidæ, 9 spp.
Conus extenuatus, Tate.
Cypræa leptorhyncha, McCoy.
†Erato australis, Tate.
*Erato minor, Tate.
Natica wintlei, T. Wds.
Natica vixumbilicata, T. Wds.
Scalaria mariæ, Tate.
Scalaria, sp. n.
Turritella septifraga, Tate.
Turritella conspicabilis, Tate.
Turritella warburtoni, T. Wds.
*Turritella acricula, Tate.
*Turritella acricula, Tate, var.
Turritella aldingæ, Tate.
Syrnola, n. sp.
*Liotia roblini, Johnston. (Recorded by Messrs. Tate and Dennant).
Calliostoma, 2 spp.
Cylichna, sp.
Entalis mantelli, Zittel.
Entalis subfissura, Tate.
†Dentalium aratum, Tate.

Aturia australis, McCoy.
Sepia, n. sp.

Of the 105 species of mollusca in the above list sixty-seven are known from the lower beds, while thirty-eight are not previously recorded from Spring Creek. Of the latter, fifteen are apparently new species, and as far as we are aware are not known elsewhere. Of the remainder which are specifically known eleven are common at Mornington and in deposits at several other places which we have associated with it. Six occur at Aldinga, five at Table Cape, and one at River Murray cliffs.

## Summary.

In our previous paper we undoubtedly attached too much importance to the polyzoal limestones, and incorrectly grouped together some which, as shown by the associated mollusca, should be placed on different horizons. Thus far we admit the force of the objections raised by Messrs. Tate and Dennant.

In default of molluscan fauna the position of most of the polyzoal rocks we mentioned is at present doubtful, but the Waurn Ponds and North Belmont limestones should be associated with the Spring Creek beds, while those at Upper Maude and Batesford are closely allied, and should be referred together to the Southern Moorabool Valley beds, which we have grouped with those of Lower Muddy Creek.

The fact that the upper of the two zones at Spring Creek is more nearly allied to the Muddy Creek beds than is the lower is another piece of evidence, the importance of which cannot be overlooked.

We are unable to accept as correct the figures on which Messrs. Tate and Dennant base the calculations adverse to our view of the succession of the beds.

On the main point in our earlier paper, namely, the relative position of the Spring Creek, Muddy Creek, and older volcanic rocks, our views are unchanged, and are based in part on the faunal agreement of the Lower Maude beds with those of Spring Creek, and in part on a comparison of the fossils of the two Spring Creek zones with those of other deposits.

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## RT. IX.—*Observations with Aneroid and Mercurial Barometers and Boiling Point Thermometers.*

By Thomas Walker Fowler, M.C.E., F.R.G.S.

[Read 10th October, 1895.]

In connection with engineering and general survey work, as ell as in geographical investigations, it is frequently conveni- ıt to determine, approximately, the attitudes of different points om observations of barometric pressure at such points. Various struments are used for this purpose, the most convenient and ›rtable being, undoubtedly, the aneroid barometer, and the ost trustworthy, the mercurial barometer of either the Fortin, · syphon type provided that the tube be of large bore. The tter requirement causes the instrument to be very heavy and either portable nor convenient. Boiling-point thermometers ›rm a third-class of instruments much less convenient than ıeroid barometers, but decidedly more portable than mercurial ıes even of small bore, as all mercurial barometers are very able to damage from destruction of the vacuum through careless andling as well as from fracture of the tube. Delicate and 'agile thermometers, undoubtedly, require careful handling, but .uch less so than mercurial barometers.

From 20th August last up to the present time, the writer made series of observations for the purpose of determining the ›lative accuracy of instruments of the classes mentioned. They 'ere made at his residence in Upper Hawthorn, Melbourne, the pproximate altitude above sea level being 200 feet, and during ıe observations the atmospheric pressure varied considerably, ıe maximum recorded being 30·048 inches, and the minimum 9·020 inches.

For use as a Standard the Acting Government Astronomer Mr. Baracchi), kindly placed at the writer's disposal a pedestal ıercurial barometer of the Fortin type, made by Newman & Son, nd numbered 122. The diameter of the tube is marked 0·380 ıch. The adjustment of the fiducial point is made by raising

behaves in a most eccentric manner, and that its variations are but very slightly indicated by the air pump test made at the Observatory on 20th December, 1894. The $1\frac{3}{4}$ inch aneroid worked very much better, but did not behave as it did under the air pump, whilst the $2\frac{1}{2}$ inch aneroid shows very well with the exception of one discordant observation, and its behaviour is very similar to what it was under the air pump.

Taking the whole of the results they fully justify (so far as they go) Mr. Edward Whymper's conclusion, "that the test which is usually applied of comparing for brief periods (minutes or hours) aneroids with mercurial barometers under the air pump is of little or no value in determining the errors which will appear in aneroids used at low pressure for long periods (weeks or months)."—"How to use the Aneroid," page 9.

The behaviour of the small bore Mountain mercurial is at first sight very peculiar, but is, undoubtedly, due to varying capillary action in the small instrument. No measurements of the heights of the meniscus were taken, but it was apparent that these were continually varying both in upper and lower limbs though principally in the latter where the meniscus at times entirely disappeared, and at other times exceeded considerably that in the upper limb. In every case the instrument was well tapped prior to taking a reading. It would appear that the readings of this barometer could be depended on to about 0·03 inch, and the error would be independent of altitude.

The boiling-point experiments resolve themselves into two sections, one taken with a glass spirit lamp, which was not sufficiently powerful to maintain a good supply of steam, and the other with a brass lamp which generated steam with ease. As might be expected the boiling points given by the former are all lower than those given by the latter. One of the observations (that on the 26th August, 4 p.m.) should undoubtedly be rejected, as the apparatus was at the time undergoing alterations and consequently the bulb was exposed to a mixture of air and steam instead of pure steam. Taking the second set of observations (sixty-seven in number), the maximum difference in the correction to standard is 0·048 inch as against 0·068 inch with the Mountain mercurial.

It may be mentioned that of eighty-one observations in all, ıirty were taken with Yan Yean water, and the rest with rain ater, but no perceptable difference in pressure was indicated 'om the alteration.

So far as they go the observations tend to show that pressures ɜtermined from boiling points are fairly trustworthy. It ɔmains to be seen, however, how much the index error of the ıermometer will vary with time, and this can only be done by ɔpeating the experiments after the lapse of some years. Further ıe writer has not had the opportunity of applying the method at

After the word "giving" on line 13, page 173, insert, "1016 feet,".

ɔvelling. **The first three observations were taken with ther-** ıometers much less sensitive than that described above. The neroid barometers gave the following heights for the same ıountain. Watkin (two observations) 1057 feet and 1082 feet. 'he $2\frac{1}{2}$ inch (two observations) 961 feet and 1042 feet; and the $\frac{3}{4}$ inch (one observation) 927 feet.

Boiling-point thermometers are condemned emphatically by Ir. Whymper as the result of his experiments on the Andes, ut the apparatus used by him seems to be much less sensitive han that used by the writer. Boiling-point thermometers re generally graduated from about 180 degs. to 212 degs., nd are about 12 inches long, the bulbs are placed close o the water of which the supply is very limited, and the eating arrangements appear to be of a meagre character. In ome experiments made by the writer with a Greiner Boiling-'oint apparatus, constructed about 1860, and filled with water o as to just touch the bottom of the bulb, the water had all ıoiled away before the "pumping" action of the thermometer ad ceased. Mr. Whymper's experiments were made with Ienderson's apparatus, in which the heating agent is a composi-ion candle. The writer has not used this apparatus, but uestions its ability to give a full supply of steam at a high ltitude.

behaves in a most eccentric manner, and that its variations are but very slightly indicated by the air pump test made at the Observatory on 20th December, 1894. The 1¾ inch aneroid worked very much better, but did not behave as it did under the air pump, whilst the 2½ inch aneroid shows very well with the exception of one discordant observation, and its behaviour is very similar to what it was under the air pump.

Taking the whole of the results they fully justify (so far as they go) Mr. Edward Whymper's conclusion, "that the test which [illegible] comparing for brief periods (minutes or

[illegible]

or months). [illegible]

The behaviour of the small bore Mountain mercurial is at first sight very peculiar, but is, undoubtedly, due to varying capillary action in the small instrument. No measurements of the heights of the meniscus were taken, but it was apparent that these were continually varying both in upper and lower limbs though principally in the latter where the meniscus at times entirely disappeared, and at other times exceeded considerably that in the upper limb. In every case the instrument was well tapped prior to taking a reading. It would appear that the readings of this barometer could be depended on to about 0·03 inch, and the error would be independent of altitude.

The boiling-point experiments resolve themselves into two sections, one taken with a glass spirit lamp, which was not sufficiently powerful to maintain a good supply of steam, and the other with a brass lamp which generated steam with ease. As might be expected the boiling points given by the former are all lower than those given by the latter. One of the observations (that on the 26th August, 4 p.m.) should undoubtedly be rejected, as the apparatus was at the time undergoing alterations and consequently the bulb was exposed to a mixture of air and steam instead of pure steam. Taking the second set of observations (sixty-seven in number), the maximum difference in the correction to standard is 0·048 inch as against 0·068 inch with the Mountain mercurial.

t may be mentioned that of eighty-one observations in all, ·ty were taken with Yan Yean water, and the rest with rain ;er, but no perceptable difference in pressure was indicated m the alteration.

So far as they go the observations tend to show that pressures ermined from boiling points are fairly trustworthy. It iains to be seen, however, how much the index error of the rmometer will vary with time, and this can only be done by eating the experiments after the lapse of some years. Further writer has not had the opportunity of applying the method at isiderable altitudes, though determinations of the height of thur's Seat made by him with boiling thermometers were rly satisfactory, four determinations giving 1016 feet, 981 feet l 986 feet respectively, as against 996 feet determined by spirit elling. The first three observations were taken with ther-meters much less sensitive than that described above. The eroid barometers gave the following heights for the same untain. Watkin (two observations) 1057 feet and 1082 feet. e 2½ inch (two observations) 961 feet and 1042 feet; and the inch (one observation) 927 feet.

Boiling-point thermometers are condemned emphatically by r. Whymper as the result of his experiments on the Andes, t the apparatus used by him seems to be much less sensitive an that used by the writer. Boiling-point thermometers e generally graduated from about 180 degs. to 212 degs., id are about 12 inches long, the bulbs are placed close the water of which the supply is very limited, and the ating arrangements appear to be of a meagre character. In me experiments made by the writer with a Greiner Boiling-oint apparatus, constructed about 1860, and filled with water as to just touch the bottom of the bulb, the water had all oiled away before the "pumping" action of the thermometer id ceased. Mr. Whymper's experiments were made with enderson's apparatus, in which the heating agent is a composi-on candle. The writer has not used this apparatus, but iestions its ability to give a full supply of steam at a high titude.

## Appendix A.

Corrections to reading of Boiling-point thermometer as per Kew Certificate. Corrections to nearest 0°·05.

From 194° to 205° (tested at 8 points on scale) +0°·15
At 212° - - - - - +0°·10

Corrections to Aneroids as per tests at Melbourne Observatory.

| Pressure. | Watkin. | $2\frac{1}{2}$ inch. | $1\frac{3}{4}$ inch. |
|---|---|---|---|
| 30·5 | +0·07 | +0·07 | ... |
| 30·0 | +0·10 | 0·00 | +0·17 |
| 29·0 | +0·10 | −0·08 | +0·05 |
| 28·0 | +0·05 | −0·15 | −0·02 |
| 27·0 | −0·23 | −0·27 | −0·09 |
| 26·0 | ... | −0·31 | −0·14 |
| 25·0 | ... | −0·33 | −0·20 |
| 24·0 | ... | −0·33 | ... |

Results of Observations expressed as corrections to make Observed readings of instruments agree with that of Standard. Barometer pressure corresponding to boiling point by Guyot's Tables.

| Date. | | Time. | Standard Mercurial at 32 degrees. | Mountain Mercurial Correction. | Aneroid Corrections. | | | Boiling Point Thermometer Correction. |
|---|---|---|---|---|---|---|---|---|
| | | | | | Watkin. | 2½ inch. | 1¾ inch. | |
| | | | " | " | " | " | " | " |
| Aug. | 20 | 8 a.m. | 29·484 | −0·058 | ... | ... | −0·136 | ... |
| | 21 | 8 a.m. | 29·491 | −0·043 | ... | ... | −0·129 | ... |
| | 22 | 8 a.m. | 29·640 | −0·051 | ... | ... | −0·080 | −0·044 |
| | | 9 p.m. | 29·473 | −0·060 | ... | ... | ... | −0·053 |
| | 23 | 4·45 p.m. | 29·427 | −0·061 | | | −0·123 | −0·046 |
| | 24 | 9 a.m. | 29·422 | −0·060 | −0·055 | −0·068 | −0·128 | ... |
| | | 9.50 a.m. | 29·401 | −0·064 | ... | ... | ... | −0·048 |
| | | 1 p.m. | 29·284 | −0·053 | ... | ... | ... | −0·035 |
| | | 2.40 p.m. | 29·207 | −0·045 | ... | ... | ... | −0·037 |
| | | 4 p.m. | 29·169 | −0·046 | ... | ... | ... | −0·040 |
| | | 6 p.m. | 29·129 | −0·042 | ... | ... | ... | −0·045 |
| | 25 | 9.15 a.m. | 29·139 | −0·046 | +0·027 | −0·091 | −0·121 | ... |
| | | 10 a.m. | 29·149 | −0·037 | ... | ... | ... | −0·048 |
| | | 4.45 p.m. | 29·174 | −0·040 | ... | ... | ... | −0·053 |
| | 26 | 8.15 a.m. | 29·274 | −0·025 | −0·022 | −0·076 | −0·116 | −0·045 |
| | | 4 p.m. | 29·277 | −0·028 | ... | ... | ... | +0·004 |
| | | 6.30 p.m. | 29·298 | −0·016 | ... | ... | ... | −0·045 |
| | 27 | 8 a.m. | 29·141 | −0·051 | +0·027 | −0·089 | −0·049 | −0·044 |
| | | 7.45 p.m. | 29·134 | −0·026 | ... | ... | ... | −0·069 |

## APPENDIX B—*(Continued).*

| Date. | | Time. | Standard Mercurial at 32 degrees. | Mountain Mercurial Correction. | Aneroid Corrections. Watkin. | Aneroid Corrections. 2½ inch. | Aneroid Corrections. 1¾ inch. | Boiling Point Thermometer Correction. |
|---|---|---|---|---|---|---|---|---|
| Aug. | 28 | 8 a.m. | 29·281 | − 0·038 | − 0·023 | − 0·079 | − 0·119 | − 0·097 |
| | | 8.30 p.m. | 29·535 | − 0·043 | .. | ... | ... | − 0·049 |
| | 29 | 8.30 a.m. | 29·731 | − 0·040 | − 0·275 | − 0·029 | − 0·039 | − 0·060 |
| | | 8 p.m. | 29·742 | − 0·044 | ... | .. | ... | − 0·061 |
| | 30 | 9.15 a.m. | 29·596 | − 0·064 | − 0·148 | − 0·134 | − 0·164 | ... |
| | | 9.45 a.m. | 29·581 | − 0·065 | ... | ... | ... | − 0·056 |
| | | 8 p.m. | 29·586 | − 0·021 | − 0·231 | − 0·044 | − 0·094 | − 0·063 |
| | 31 | 8.30 a.m. | 29·770 | − 0·045 | − 0·321 | − 0·030 | − 0·050 | ... |
| | | 8.45 a.m. | 29·777 | − 0·045 | ... | ... | ... | − 0·061 |
| | | 6 p.m. | 29·671 | − 0·067 | ... | ... | ... | − 0·061 |
| Sept. | 1 | 9.15 a.m. | 29·685 | − 0·053 | − 0·343 | − 0·035 | − 0·075 | ... |
| | | 9.45 a.m. | 29·685 | − 0·051 | ... | ... | ... | − 0·059 |
| | | 3 p.m. | 29·664 | ... | ... | ... | ... | − 0·065 |
| | | 6.45 p.m. | 29·674 | .. | .. | ... | ... | − 0·070 |
| | 2 | 8.15 a.m. | 29·513 | − 0·059 | − 0·079 | − 0·057 | − 0·087 | ... |
| | | 8.45 a.m. | 29·498 | ... | ... | ... | ... | − 0·062 |
| | | 1 p.m. | 29·279 | ... | − 0·028 | ... | ... | − 0·058 |
| | | 8.15 p.m. | 29·083 | ... | + 0·017 | ... | ... | − 0·061 |
| | | 11.15 p.m. | 29·020 | ... | + 0·031 | ... | | − 0·060 |
| | 3 | 8 a.m. | 29·204 | − 0·042 | + 0·011 | − 0·096 | − 0·146 | ... |
| | | 8.15 a.m. | 29·209 | ... | ... | ... | ... | − 0·052 |
| | | 8 p.m. | 29·290 | ... | + 0·013 | ... | ... | − 0·053 |
| | 4 | 8 a.m. | 29·262 | − 0·041 | − 0·022 | − 0·098 | − 0·138 | ... |
| | | 8.20 a.m. | 29·269 | ... | ... | ... | ... | − 0·062 |
| | | 5 p.m. | 29·246 | ... | ... | ... | ... | − 0·061 |
| | | 8 p.m. | 29·240 | ... | ... | | ... | − 0·056 |
| | 5 | 8 a.m. | 29·354 | − 0·041 | − 0·026 | − 0·076 | − 0·126 | ... |
| | | 9.25 a.m. | 29·397 | ... | .. | ... | ... | − 0·064 |

| Date. | | Time. | Mercurial at 32 degrees. | Mercurial Correction. | Watkin. | 2½ inch. | 1¾ inch. | Thermometer Correction. |
|---|---|---|---|---|---|---|---|---|
| | | | ″ | ″ | ″ | ″ | ″ | ″ |
| | | 8 p.m. | 29·570 | ... | ... | ... | ... | −0·067 |
| Sept. | 6 | 8.30 a.m. | 29·628 | −0·039 | −0·099 | −0·052 | −0·092 | ... |
| | | 10 a.m. | 29·535 | ... | ... | ... | ... | −0·058 |
| | | 8 p.m. | 29·579 | ... | ... | ... | ... | −0·070 |
| | 7 | 8.30 a.m. | 29·642 | −0·049 | −0·149 | −0·038 | −0·078 | ... |
| | | 9.15 a.m. | 29·656 | ... | ... | ... | ... | −0.064 |
| | | 2.45 p.m. | 29·609 | ... | ... | ... | ... | −0·069 |
| | | 7.30 p.m. | 29·646 | ... | ... | ... | ... | −0.074 |
| | 8 | 9.30 a.m. | 29·410 | −0·049 | −0·023 | −0·070 | −0·130 | .. |
| | | 10.30 a.m. | 29·413 | ... | ... | ... | ... | −0·066 |
| | | 4 p.m. | 29·396 | ... | ... | ... | ... | −0·071 |
| | | 9 p.m. | 29·438 | ... | ... | ... | ... | −0·070 |
| | 9 | 8.30 a.m. | 29·206 | −0·044 | +0·006 | −0·104 | −0·144 | ... |
| | | 10.15 a.m. | 29·176 | ... | ... | ... | ... | −0·068 |
| | | 5.30 p.m. | 29·208 | ... | ... | ... | ... | −0·065 |
| | | 9·30 p.m. | 29·332 | ... | ... | ... | ... | −0·070 |
| | 10 | 8.15 a.m. | 29·619 | −0·048 | −0·151 | −0·051 | −0·061 | ... |
| | | 8·45 a.m. | 29·636 | ... | ... | ... | ... | −0·066 |
| | | 8 p.m. | 29·741 | ... | ... | ... | ... | −0·074 |
| | 11 | 8 a.m. | 29·848 | −0·041 | −0·385 | −0·022 | −0·062 | ... |
| | | 8.30 a.m. | 29·857 | ... | ... | ... | ... | −0·065 |
| | | 9 p.m. | 29·799 | ... | ... | ... | ... | −0·075 |
| | 12 | 8.30 a.m. | 29·722 | −0·059 | −0·341 | −0·048 | −0·088 | .. |
| | | 10.15 a.m. | 29·667 | ... | ... | ... | ... | −0·065 |
| | | 9.15 p.m. | 29·876 | ... | ... | .. | ... | −0·076 |
| | 13 | 8.30 a.m. | 29·955 | −0·033 | −0·439 | −0·015 | −0·045 | ... |
| | | 10 a.m. | 29·944 | ... | ... | ... | ... | −0·073 |
| | 15 | 9.15 a.m. | 29·438 | −0·050 | −0·035 | −0·082 | −0·112 | ... |

APPENDIX B—*(Continued).*

| Date. | Time. | Standard Mercurial at 32 degrees. | Mountain Mercurial Correction. | Aneroid Corrections. Watkin. | Aneroid Corrections. 2½ inch. | Aneroid Corrections. 1¾ inch. | Boiling Point Thermometer Correction. |
|---|---|---|---|---|---|---|---|
| | | " | " | " | " | " | " |
| Sept. 16 | 8.20 a.m. | 29·491 | −0·023 | −0·061 | −0·059 | −0·079 | ... |
| | 10 a.m. | 29·458 | ... | ... | ... | ... | −0·074 |
| 17 | 8 a.m. | 29·374 | −0·040 | −0·037 | −0·076 | −0·096 | ... |
| 18 | 8.15 a.m. | 29·455 | −0·020 | −0·045 | −0·065 | −0·095 | ... |
| | 5.15 p.m. | 29·562 | ... | ... | ... | ... | −0·075 |
| 19 | 9.15 a.m. | 29·764 | −0·052 | −0·293 | −0·026 | −0·066 | ... |
| | 9.45 a.m. | 29·766 | ... | ... | ... | ... | −0·067 |
| | 8 p.m. | 29·833 | ... | ... | ... | ... | −0·077 |
| 20 | 8.30 a.m. | 29·866 | −0·050 | −0·378 | −0·024 | −0·064 | ... |
| | 9.30 a.m. | 29·866 | ... | ... | ... | ... | −0·068 |
| | 7.45 p.m. | 29·842 | ... | ... | ... | ... | −0·074 |
| 21 | 8.30 a.m. | 29·897 | −0·043 | −0·406 | −0·023 | −0·033 | ... |
| | 10 a.m. | 29·895 | ... | ... | ... | ... | −0·069 |
| 22 | 9 a.m. | 29·849 | −0·055 | −0·402 | −0·021 | −0·031 | ... |
| | 12 noon | 29·831 | ... | ... | ... | ... | −0·063 |
| 23 | 5 p.m. | 29·768 | −0·066 | −0·340 | −0·042 | −0·063 | ... |
| 24 | 8 a.m. | 29·873 | −0·040 | −0·390 | −0·027 | −0·027 | ... |
| | 9 p.m. | 29·844 | ... | ... | ... | ... | −0·078 |
| 25 | 8 a.m. | 29·823 | −0·054 | −0·385 | −0·037 | −0·047 | ... |
| | 8.5 a.m. | 29·820 | ... | ... | ... | ... | −0·072 |
| | 7.45 p.m. | 29·738 | ... | ... | ... | ... | −0·089 |
| 26 | 8.15 a.m. | 29·757 | −0·050 | −0·345 | −0·043 | −0·073 | ... |
| | 9.45 a.m. | 29·755 | ... | ... | ... | ... | −0·066 |
| | 9 p.m. | 29·748 | ... | ... | ... | ... | −0·070 |
| 27 | 8.15 a.m. | 29·840 | −0·048 | −0·386 | −0·030 | −0·060 | ... |
| | 9.40 a.m. | 29·843 | ... | ... | ... | ... | −0·073 |
| 28 | 8.30 a.m. | 29·933 | −0·033 | −0·460 | −0·017 | −0·037 | ... |
| | 10 a.m. | 29·925 | ... | ... | ... | ... | −0·074 |

| Date. | | Time. | Standard Mercurial at 32 degrees. | Mountain Mercurial Correction. | Aneroid Corrections. Watkin | Aneroid Corrections. 2½ inch. | Aneroid Corrections. 1¾ inch. | Boiling Point Thermometer Corrections. |
|---|---|---|---|---|---|---|---|---|
| | | | ″ | ″ | ″ | ″ | ″ | ″ |
| Sept. | 29 | 9.15 a.m. | 30·022 | −0·082 | −0·476 | 0·008 | −0·018 | . |
| | | 2.15 p.m. | 29·964 | .. | | | | −0·077 |
| | | 9.45 p.m. | 30·029 | . | .. | ... | .. | −0·084 |
| | 30 | 8 p.m. | 29·859 | −0·062 | −0·404 | −0·031 | −0·071 | ... |
| | | 9 p.m. | 29·855 | ... | . | . | . | −0·085 |
| Oct. | 1 | 8 a.m. | 29·768 | −0·061 | −0·352 | −0·052 | 0·082 | ... |
| | 2 | 8 a.m. | 29·542 | −0·040 | −0·110 | −0·078 | −0·128 | ... |
| | | 9.15 p.m. | 29·693 | | . | .. | | −0·081 |
| | 3 | 8.45 a.m. | 29·861 | −0·053 | −0·381 | −0·039 | −0·069 | .. |
| | | 10.45 a.m. | 29·873 | . | ... | ... | . | −0·079 |
| | | 8.30 p.m. | 29·982 | . | ... | .. | ... | 0·089 |
| | 4 | 8.15 a.m. | 30·048 | −0·024 | −0·462 | +0·008 | −0·012 | ... |
| | | 9.30 a.m. | 30·018 | | | .. | | −0·077 |
| | 5 | 8.15 a.m. | 29·831 | −0·076 | −0·401 | −0·039 | −0·059 | .. |
| | | 10.30 a.m. | 29·788 | | ... | ... | .. | −0·080 |
| | | 6 p.m. | 29·646 | | .. | ... | . | −0·086 |
| | 6 | 9.30 a.m. | 29·568 | −0·058 | −0·160 | −0·072 | −0·122 | .. |
| | | 11 a.m. | 29·553 | ... | .. | . | ... | −0·072 |
| | 7 | 8 a.m. | 29·309 | −0·049 | −0·027 | −0·101 | −0·151 | . |
| | | 10 a.m. | 29·244 | .. | .. | . | . | −0·075 |
| | 8 | 8.15 a.m. | 29·490 | −0·046 | −0·067 | 0·080 | −0·100 | ... |
| | 9 | 8.45 a.m. | 29·689 | −0·041 | −0·241 | −0·061 | −0·091 | .. |

Remarks. Boiling points up to and including 27th August, at 8 a.m. with glass spirit lamp which did not give a plentiful supply of steam. Subsequent ones with a brass lamp which keeps better steam. Yan Yean water used till 2nd September inclusive. All subsequent observations with rain water.

## Art X.—*Observed Variations in the Dip of the Horizon.*

[Abstract of paper read before the Royal Society of Victoria, on 13th June, 1895.]

By Thomas Walker Fowler, M.C.E., F.R.G.S., F.G.S.

The observations recorded in the table herewith were made with a 12 inch Theodolite, by Troughton & Simms, reading by verniers to 10″. The elevation of the horizontal axis was 132 feet above mean sea level as determined by spirit levelling, and a few days tide gauging the range of tide observed varying from 6′ 6″ to 10′. The station was (approximately) in latitude 38° 22′ S. Longitude 144° 46′ E., and the observations were taken in part by the writer and in part by engineering students of the Melbourne University. From the instrument station good views could be obtained to the south over part of Bass Strait (average depth about 35 fathoms), and to the north over part of Port Phillip Bay (average depth about 5 fathoms) as well as to Arthur's Seat, distant 9 nautical miles to the eastward, and elevated 996 feet above mean water level of Port Phillip Bay as determined by spirit levelling. The angles of elevation were taken to a point on the look-out tower 20 feet above the summit, or 1016 feet above mean water level of Port Philip Bay.

The observations were taken during very hot weather, when the difference between air and sea temperatures was large. The sea temperature to the south (in Bass Strait) was about 67°, that to the north (in Port Phillip Bay) was not observed, but, no doubt was higher.

The normal dip under average temperature and pressure would be 0° 11′ 20″ as against the maximum and minimum observed of 0° 21′ 35″ and 0° 5′ 5″ respectively. Reference may be made to "Raper's Navigation," pages 61 and 194, for further observations on this point.

The altitude of point sighted to on Arthur's Seat, according to the smallest observed angle, is 1003 feet; according to the largest observed angle 1043 feet; and according to the mean angle 1031

it as against 1016 feet as determined by spirit levelling. These itudes are computed with co-efficient of refraction = 0·083. iing the lower values quoted by American writers these itudes would be increased by two feet. Reference may be de to Appendix XVI. "U.S. Coast and Geodetic Survey port for 1876" for interesting information about somewhat nilar observations. The American observations, as well as writer's, give for observations taken from the lower station a ference of elevation greater than the true one. This can be plained on the assumption that the path of the ray between the tions is not a circular curve but one whose radius of curvature greater at the higher station than at the lower one. As the is denser at the lower station this is to be expected.

Attention may be directed to the remarkably small variations the observed angles of elevation to Arthur's Seat compared th the large variations in the dip of the horizon.

The observations support the following deductions, which are t however advanced as new :—That under abnormal conditions dip may differ greatly from the ordinary tabular value, that may be unequal in different parts of the horizon, and that it y vary very rapidly especially in the afternoon. That at nparatively moderate angles of elevation the abnormal refrac- n is greatly diminished and that under unfavourable conditions the atmosphere, altitudes determined by angles of *elevation* of out one degree observed from moderate distances are quite as iable as elevations determined from a few barometric observa- ns.

## Observed Dips, etc.

| Date. | Time. | Air Temp. | Watkin Aneroid. | Dip South. | Dip North. | Elevation Arthur's Seat. | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | | ° ′ ″ | ° ′ ″ | ° ′ ″ | |
| Feb. 12 | 3.45 p.m. | 93·8 | 29·958 | 0 9 15 | 0 11 0 | 0 53 5 | Instrument normal. |
| | 4.15 p.m. | 93·8 | 29·955 | 0 7 37½ | 0 13 35 | 0 53 0 | Instrument reversed. |
| | 5 p.m. | 94·3 | 29·943 | 0 8 55 | 8 8 45 | 0 53 25 | Instrument normal. |
| | 5.15 p.m. | 92·5 | 29·938 | 0 11 25 | 0 9 25 | Covered with haze | Instrument reversed. |
| 13 | 9.40 a.m. | 82·8 | 30·061 | 0 8 40 | 0 8 50 | 0 52 40 | Instrument normal. |
| | 10.15 a.m. | 84·4 | 30·052 | 0 8 50 | 0 8 15 | 0 52 10 | Instrument reversed. |
| | 12.15 p.m. | 91·8 | 30·033 | 0 7 30 | 0 5 5 | 0 52 45 | Instrument normal. |
| | 12.30 p.m. | 92·4 | 30·032 | 0 7 25 | 0 5 25 | 0 52 55 | Instrument reversed. |
| | 3.15 p.m. | 96·7 | 30·008 | 0 21 35 | 0 8 55 | 0 51 5 | Inst. normal. Temp. when sighting to A. Seat 88° |
| | 3.25 p.m. | 82·0 | 30·008 | Covered | with haze | 0 53 35 | Instrument reversed. |
| 14 | 4 p.m. | 81·0 | 30·008 | 0 11 30 | Covered | with haze | Inst. normal. Cool S. wind. Hazy. |
| 15 | 3 p.m. | 88·4 | 22·920 | Haze | 0 7 30 | Haze | Instrument normal. |
| | 3.5 p.m. | 81·8 | 29·910 | Haze | 0 9 25 | Haze | Instrument reversed. |
| 17 | 12 noon | 86·0 | 29·540 | 0 9 30 | 0 9 50 | 0 53 15 | Instrument normal. North wind. No sun. |
| | 12.15 p.m. | 86·0 | 22·540 | 0 10 10 | 0 9 30 | 0 53 0 | Instrument reversed. North wind. No sun. |
| March 1 | 10.45 a.m. | 69·0 | 29·919 | 0 12 5 | 0 12 5 | 0 52 50 | Instrument normal. |
| | 11 a.m. | 69·0 | 29·919 | 0 10 15 | 0 11 45 | 0 53 5 | Instrument reversed. |

T. XI.—*Note on a Victorian Host of the Larval Stages of the Liver Fluke (Distoma hepaticum).*

By Thomas Cherry, M.D.

[Read 12th December, 1895.]

During the last six months I have made frequent examination snails from various parts of the colony, with the view of covering the intermediate host of the common sheep fluke— *hepaticum.* The snails have been procured through the Stock partment and have come chiefly from the western and north-stern districts. Nothing of importance was revealed by the sections made during the winter, but about a fortnight ago a ge specimen of *Bulinus tenuistriatus* was found containing a y large number of rediæ and cercariæ. Since that time the ne forms have been found in several snails of the same species, well as minute white bodies which I believe to be the rocysts. The cercariæ correspond in every particular to measurements and description given by Thomas in the Journ. Mic. Science., Vol. XXIII. The snails from which I ve so far obtained these larval forms have been sent from the d waters of the Wimmera. They are very numerous in the eks and swamps, and this species is perhaps the commonest d most widely distributed species of snail in Victoria. A mber of specimens of *Limnæa venustula* from the same creeks ve been examined, but have been found free of the larval fluke. vestigations as to the occurrence of similar forms in other rts of Victoria are being continued at the University, and periments will be carried out with the view of determining eir identity with *D. hepaticum.* The above species of snail pears to be a different species from that in which Dr. Cobb scovered the larval forms, as reported by the *Age*, 2nd Nov., 95. I am indebted to Mr. G. B. Pritchard for identifying e snails.

Note.—Since the above paper was read I have observed the me rediæ and cercariæ in specimens of *B. tenuistriatus* from all e southern and western parts of the colony.

# ANNUAL REPORT OF THE COUNCIL

## For the Year 1894-95.

The Council of the Royal Society herewith presents to the Members of the Society the Annual Report and Balance Sheet for the Year 1894.

The following Meetings were held, and Papers read during the Session:

March 8.—"Observations made at Sydney with Kater's Invariable Pendulums during January and February, 1894," by E. F. J. Love, M.A. "Description of some Birds' Eggs from North Queensland," by Dudley Le Souëf. "Notes on some Lancefield Graptolites," by G. B. Pritchard. (1) "Note on the presence of Peripatus insignis in Tasmania," and (2) "Preliminary Notes on some Tasmanian Earthworms," by Professor W. Baldwin Spencer, M.A.

April 12.—An adjourned discussion on Mr. Love's paper on "Kater's Pendulums," etc., in which Professor W. C. Kernot, M.A., C.E.; R. L. J. Ellery, C.M.G., F.R.S., F.R.A.S.; Pietro Baracchi, F.R.A.S.; Thos. W. Fowler, C.E.; and E. F. J. Love, M.A., took part "Land Irrigation—Principles Governing its Economic Application," by Isaac Tipping, C.E.

May 10.—"The Geology of Castlemaine, with a Subdivision of the Lower Silurian Strata, and a list of Minerals," by T. S. Hall, M.A. "On the Sugar Strength and Acidity of Victorian Musts," by W. Percy Wilkinson.

June 14.—"A Demonstration explanatory of the Modern Theories of the Coagulation of the Blood, and the Action of Snake Venom on the Blood," by J. W. Barrett, M.D. "Geological Notes on the Country between Strahan and Lake St. Clair, Tasmania," by C. G. W. Officer, B.Sc., Lewis J. Balfour, and E. G. Hogg, M.A.

July 12.—"The Best Form for a Balance-Beam," by Professor W. C. Kernot. "Australian Species of Amathia," by Dr.

acGillivray, M.A., etc. "Aboriginal Rock Paintings and ,rvings in New South Wales," by R. H. Mathews. "Note on e Occurrence of Fossil Bones at Werribee," by G. B. Pritchard. A New Stone Making Fungus *(Laccocephalum basilapiloides)*," D. McAlpine and J. G. O. Tepper.

August 9.—"The Entomogenous Fungi of Victoria, Part I., *ria oncopteræ*," by D. McAlpine and W. H. F. Hill. "Crema- n and Burial in Relation to Death Certification," by H. K. ısden. "A Demonstration of Joly's Melting Apparatus and ly's Steam Calorimetre," by Professor T. R. Lyle, M.A. "A emonstration of a New Micrometric Machine to be used in the easurement of the Astrograph Star Plates, and in Determining e Size of the Star Discs, for the Estimation of Stellar Magni- des," by R. L. J. Ellery, C.M.G., F.R.S., F.R.A.S.

September 13.—"An Attempt to Estimate the Population of elbourne at the Present Time," by James Jamieson, M.D. The Older Tertiaries of Maude, with an Indication of the quence of the Eocene Beds of Victoria," by T. S. Hall, M.A., d G. B. Pritchard. "A Molluscan Genus new to, and other forgotten from, Australia," by C. Hedley (communicated G. B. Pritchard). "An Exhibition of a New Automatic ecording Compass," by A. Foster Smith.

November 8.—"Contributions to the Palæontology of the lder Tertiary of Victoria, *Lamellibranchs*, Part I.," by G. B. itchard. (1) "Notes on Birds," (2) "The Gymnorhinæ or ustralian Magpies, with a description of a New Species," by . J. Campbell. "Preliminary Notes on certain Marsupials om Central Australia," by Professor W. Baldwin Spencer, M.A. Australian Fungi," by D. McAlpine.

December 13.—"Some Quantitative Laws in Incubation and estation," by Alex. Sutherland, M.A. "Preliminary Account certain Lizards from Central Australia," by A. H. S. Lucas, .A., and C. Frost. "A Monograph of the Tertiary Polyzoa of ictoria," by Dr. MacGillivray, M.A., etc. "Catalogue of Non- alcareous Sponges collected by J. Bracebridge Wilson, Esq., in e Neighbourhood of Port Phillip Heads, Part I.," by Professor rthur Dendy, D.Sc.

During the course of the year, three Members, one Country Member, and ten Associates have been elected, and eight Members, one Country Member, and four Associates have

resigned. Professor Arthur Dendy, D.Sc., has been elected a Corresponding Member of the Society.

The Librarian reports as follows:—

"During the past twelve months, 1236 books and parts of periodicals have been received. The applications made by the Sub-Librarian for copies of volumes or parts of volumes missing from various series of publications have met with much success. Owing to lack of funds, very little binding has been done during the year, though it will be necessary to incur some expense in connection with this if the library is to be maintained in an efficient state. The whole library has been carefully inspected by the Sub-Librarian, with the view of making a catalogue, which will be of service to members of the Society."

During the year the following publication has been issued:—
"Proceedings," Vol. VII., New Series.

There has been no lack or falling off, but rather an increase in the number of Memoirs presented to the Society, and with a diminished income the Council is feeling the difficulty of adequately publishing the work which is brought before it.

There is at the present moment a new Volume of the Transactions in the press, which the Council has decided to devote to the publication of Dr. MacGillivray's monograph on the "Fossil Polyzoa of Victoria." It will be illustrated by twenty-two quarto lithographic plates, executed by Mr. Wendel, whose admirable and conscientious work has been of no little benefit to the Society during the past few years.

The work entrusted to the Gravity Survey and Port Phillip Biological Committees still continues to make progress, and both Committees hope to publish valuable results during the course of the coming year.

It is gratifying to notice that, though there has been an unavoidable slight falling off in the number of Members, the interest taken in the Monthly Meetings has been more than maintained, whilst the publication of Memoirs has been on a somewhat larger scale than that of the past one or two years.

Whilst there is no lack of material constantly available for publication, the nature and amount of this must depend entirely upon the financial position of the Society, and in increasing the stability of this, the Council relies upon the cordial support of the Members and Associates.

## Dr. *The Honorary Treasurer in Account with the Royal Society of Victoria.* Cr.

| | £ s. d. | £ s. d. |
|---|---|---|
| To Balance from 28th February, 1894 ... | | £188 18 4 |
| ,, Government Grant— | | |
| Balance of Vote 1893-94 | £60 0 0 | |
| Instalments for 1894-95 | 50 0 0 | |
| | | 110 0 0 |
| ,, Entrance Fees ... ... ... | | 16 16 0 |
| ,, Subscriptions— | | |
| Members .. | £79 14 0 | |
| Country Members ... | 9 9 0 | |
| Associates ... | 32 11 0 | |
| Arrears ... ... | 48 6 0 | |
| | | 170 0 0 |
| ,, Rent of Rooms ... ... ... | | 8 15 0 |
| ,, Sale of Transactions ... ... ... | | 16 8 9 |
| ,, Interest ... ... ... ... | | 17 0 0 |
| | | £527 18 1 |

| | £ s. d. |
|---|---|
| By Printing and Stationery ... ... | £156 8 9 |
| ,, Rates ... ... ... ... | 3 10 0 |
| ,, Gas and Fuel ... ... ... | 7 16 10 |
| ,, Salary, etc., of Assistant Secretary ... | 100 0 0 |
| ,, Hall-keeper's Allowance ... ... | 4 10 0 |
| ,, Collector's Commission ... .. | 16 15 8 |
| ,, Gratuity to Collector ... ... | 5 0 0 |
| ,, Insurance ... ... ... ... | 4 0 0 |
| ,, Postages ... ... ... ... | 19 2 8 |
| ,, Repairs ... .. ... ... | 8 8 0 |
| ,, Books and Periodicals ... ... | 4 14 0 |
| ,, Freight ... ... ... ... | 6 12 6 |
| ,, Refreshments ... ... ... | 4 15 8 |
| ,, Binding ... ... ... ... | 3 19 3 |
| ,, Gravity Survey Expenses ... ... | 3 16 0 |
| ,, Incidentals ... ... ... ... | 8 8 1 |
| ,, Balance (28th February, 1895) ... | 170 0 8 |
| | £527 18 1 |

## PUBLISHING AND RESEARCH FUND.

| Dr. | | | | | Cr. | | | |
|---|---|---|---|---|---|---|---|---|
| To Fixed Deposit in Bank ... ... | £300 | 0 | 0 | | By Fixed Deposit in Bank of Australasia | £300 | 0 | 0 |
| „ Interest on same ... ... ... | 13 | 10 | 0 | | „ Interest transferred to General Account | 13 | 10 | 0 |
| | £313 | 10 | 0 | | | £313 | 10 | 0 |

Compared with the vouchers and Bank Pass-book and Cash-book, and found correct,

C. R. BLACKETT,
*Hon. Treasurer.*

H. MOORS,
JAS. E. GILBERT, } *Auditors.*

28*th February*, 1895.

# REPORTS OF COMMITTEES.

## (1) House Committee.

'he Committee, consisting of Mr. C. R. Blackett, F.C.S., n. Treasurer, Professor Kernot, M.A., C.E., President, and K. Rusden, Esq., Vice-President, inspected building and unds on February 8th, 1895, at 4 p.m. Found house in good er and well-kept, but paint on window sashes, doors, etc., y old, and in places wood exposed and perishing. In the unds the fence, though continually repaired by custodian, ether with the main gate, very old; at the south side fence ırly falling.

Had window-sashes and front door painted with two coats of nt, a room in the cottage repapered, spouts and all gutters on of of hall examined and cleaned, at a cost of £4 2s. 6d. othing has been done to fence except pickets continually ıewed by custodian.

Mr. Love has sent an estimate of cost for shelving which must put up in Library owing to the quantity of books received.

Except the above, no expense has been incurred during the st year owing to lack of funds.

C. R. Blackett.

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## (2) Antarctic Exploration Committee.

Your Sub-Committee has to report holding two meetings .ring the past twelve months. No active steps have been ssible, but the project has developed interesting and encourag- g phases. The steam whaler, "Antarctic," of Tousberg, ıptain Christensen, left Melbourne for the Antarctic in ctober, 1894, as the result of the interest created in the region r the active agitation of the Committee during the past ten ears. The vessel reached 74° S.L., and the crew landed, being ıe first persons known to have trodden the mainland. The sults of the visit have been published with a chart of the

voyage. Some low forms of vegetable life were secured, and a small collection of birds and fishes also. The seals killed bore wounds, which the whalemen declared could have been inflicted by polar bears, or, by an animal similarly armed. The wounds were large deep gashes, always found on the lower part of the back. Meteorological observations were made, and records of sea temperatures taken. Mr. E. C. Borchgrevinck, a surveyor, joined the ship as a seaman, and has been the means of recording the information of scientific value which has come to hand, and his services were performed under grave disadvantage and deserve our recognition.

The accounts of the voyage have kindled new interest in the project throughout the world, and we hear rumours of early expeditions starting from Great Britain, America and Germany.

It is to be hoped that the influence of the learned societies of Great Britain, now being exerted to get the Royal Navy to despatch an expedition fully equipped for scientific research, will be crowned with success at an early date.

G. S. GRIFFITHS.

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## (3) GRAVITY SURVEY COMMITTEE.

Your Committee has only a brief report to present this year. Since the date of the last report the secretary has returned from England, where he secured sets of swings with the new half-second pendulums at the Observatories of Greenwich, Kew, and Cambridge. Since his return he has been occupied, in conjunction with Mr. Baracchi, in the making of a new set of observations for comparison with those taken last year. These observations, as well as those made in England, are now undergoing reduction.

It is hoped that the determination of correcting factors may be completed in the course of the summer, so that no further difficulty may hinder the extension of the survey throughout Australia.

Your committee desires to be re-appointed.

E. F. J. LOVE.

## (4) Port Phillip Biological Committee.

There is little to report with regard to the work of the Port Phillip Biological Committee during the past year.

Dr. Dendy has continued his researches with regard to the Sponges, and has issued his second instalment of the catalogue of non-calcareous forms.

Mr. Sykes has apparently completed his investigations on the Polyplacophora, the results of which he is communicating to the Malacological Society, London. It is a matter of much regret that owing to lack of funds, these results cannot be published by the Royal Society of Victoria.

Mr. Pritchard is still at work upon the Gastropoda and Lamellibranchiata. It is hoped that during the course of the year reports will be received from naturalists who have been for some time at work upon various parts of the collection.

The Committee desires to place on record its sense of the great loss sustained by the society in the death of Mr. Bracebridge Wilson, M.A., F.L.S. It is to the long continued labours of Mr. Wilson that the society owes almost entirely the large collection of Port Phillip Biological specimens which it has been enabled to distribute to various naturalists for investigation. Mr. Wilson's labours have resulted already in the acquisition of much knowledge with regard to the fauna and flora of Port Phillip Bay, his knowledge of and personal acquaintance with which were unrivalled. The whole of Mr. Wilson's vacations were spent on board his yacht dredging in the bay and along the coast, and all his results were placed unreservedly at the disposal of the Society, his only anxiety being that they might lead on to the full determination of the fauna and flora of the Port Phillip Bay and the Victorian coast.

# The Royal Society of Victoria.

## LIST OF MEMBERS,

*WITH THEIR YEAR OF JOINING.*

### Honorary Members.

| | |
|---|---|
| Agnew, Hon. J. W., M.E.C., M.D., Hobart, Tasmania ... | 1888 |
| Clarke, Colonel Sir Andrew, K.C.M.G., C.B., C.I.E., (*President*, 1855 *to* 1857), London. | 1854 |
| Forrest, Hon. J., C.M.G., Surveyor-General, West Australia. | 1888 |
| Hector, Sir James, K.C.M.G., M.D., F.R.S., Wellington N.Z. | 1888 |
| Liversidge, Professor A., F.R.S., University, Sydney, N.S.W. | 1892 |
| Neumeyer, Professor George, Ph.D., Hamburg, Germany | 1857 |
| Russell, H. C. Esq., F.R.S., F.R.A.S., Observatory, Sydney, N.S.W. | 1888 |
| Scott, Rev. W., M.A., Kurrajong Heights, N.S.W. ... | 1855 |
| Todd, Sir Charles, K.C.M.G., F.R.A.S., Adelaide, S.A. ... | 1856 |
| Verbeek, Dr. R. D. M., Buitenzorg, Batavia, Java ... | 1886 |

### Life Members.

| | |
|---|---|
| Barkly, His Excellency Sir Henry, G.C.M.G., K.C.B. (*President*, 1860 *to* 1863), Carlton Club, London. | 1857 |
| Bosisto, Joseph, Esq., C.M.G., M.L.A., Richmond ... | 1857 |
| Butters, J. S., Esq., Empire Buildings, Collins-street West | 1860 |
| Eaton, H. F. Esq., Treasury, Melbourne ... ... | 1857 |
| Elliott, J. S., Esq., Elsternwick ... ... ... | 1856 |
| Elliott, Sizar, Esq., Asling-street, Brighton Beach ... | 1856 |
| Fowler, Thomas W., Esq., M.C.E., 317 Collins-street ... | 1877 |
| Gibbons, Sydney W., Esq., F.C.S., c/o Mr. Lewis, 341 Bourke-street. | 1854 |
| Gilbert, J. E., Esq., Money Order Office, G.P.O., Melbourne | 1872 |

ɔwitt, Edward, Esq., Rathmines-road, Auburn ... 1868

ve, E. F. J., Esq., M.A., Queen's College, University 1888

ıeller, Baron F. von, K.C.M.G., M.D., Ph.D., F.R.S. (*President*, 1859), Arnold-street, South Yarra. 1854

cholas, William, Esq., F.G.S., 5 Auburn Grove, Camberwell. 1864

ısden, H. K., Esq., Ockley, corner of North-road and Hotham-street, Brighton. 1866

lby, G. W., Esq., 99 Queen-street, Melbourne ... 1881

hite, E. J., Esq., F.R.A.S., Observatory, Melbourne ... 1868

## Ordinary Members.

lan, Alex. C., Esq., Sixth Floor, Colonial Mutual Chambers, Market-street. 1867

ˈcher, W. H., Esq., J.P., F.L.S., F.I.A., Alverno, Grace Park, Hawthorn 1887

ge, William, Esq., M.I.C.E., 349 Collins-street ... 1888

lfour, Lewis, J., B.A., Esq., Tyalla, Toorak ... 1892

rnes, Benjamin, Esq., Queen's Terrace, South Melbourne 1866

racchi, Pietro, Esq., F.R.A.S., Observatory, Melbourne 1887

rrett, J. W., Esq., M.D., M.S., F.R.C.S., 34 Collins-street East 1891

ckx, Gustave, Esq., Queen's Place, St. Kilda-road ... 1880

ıckett, C. R., Esq., J.P., F.C.S., Charlesfort, Tennyson-street, South St. Kilda. 1879

mpbell, F. A., Esq., C.E., Working Men's College, Latrobe-street. 1879

ndler, Samuel Curtis, Esq., Melbourne Club ... 1888

erry, T., Esq., M.D., M.S., University, Melbourne ... 1893

hen, Joseph B., Esq., A.R.I.B.A., Public Works Department, Melbourne. 1877

ane, J. M., Esq., C.E., Fourth Floor, Prell's Buildings, Queen-street. 1888

nks, John, Esq., 391 Bourke-street West ... ... 1871

vidson, Wm., Esq., C.E., Inspector-General of Public Works, Melbourne. 1880

nnant, John, Esq., F.G.S., F.C.S., Russell-street, Camberwell. 1886

Dunn, Frederick, Esq., 306 Little Flinders-street ... 1880
Dunn, E. J., Esq., F.G.S., 77 Packington-street, Kew ... 1893

Eastick, J., Esq., The Australian Sugar Refinery Company Limited, Port Melbourne. 1893
Ellery, R. L. J., Esq., C.M.G., F.R.S., F.R.A.S., (*President*, 1866 *to* 1885), Observatory, Melbourne. 1856

Fox, W., Esq., 28 Robe-street, St. Kilda ... ... 1887
Fryett, A. G., Esq., Esplanade Hotel, St. Kilda ... 1893

Gardner, Wm., Esq., M.R.C.S., 5 Collins-street East ... 1894
Goldstein, J. R. Y., Esq., Office of Titles, Melbourne ... 1879
Gotch, J. S., Esq., 109 Albert-street, East Melbourne ... 1881
Griffiths, G. S., Esq., F.R.G.S., 313 Collins-street ... 1883

Hake, C. N., Esq., F.C.S., Melbourne Club, Melbourne ... 1890
Hall, T. S., Esq., M.A., University, Melbourne ... 1890
Hart, Ludovico, Esq., 10 Affleck-street, South Yarra ... 1883
Heffernan, E. B., Esq., M.D., 10 Brunswick-st., Fitzroy 1879
Hogg, H. R. ,Esq., M.A., 16 Market Buildings, Flinders-lane W. 1890
Hogg, E. G., Esq., M.A., Trinity College, University, Melbourne. 1894
Howitt, A. W., Esq., F.G.S., Secretary Mining Department, Melbourne. 1877

James, E. M., Esq., M.R.C.S., 71 Spring-street, Melbourne 1883
Jamieson, James, Esq., M.D., 56 Collins-street East ... 1877
Joseph, R. E., Esq., Electric Light Company, Sandridge-road, Melbourne. 1877

Kernot, Professor W. C., M.A., C.E. (*President*, 1885 *to* 1894), University, Melbourne. 1870

Lyle, Professor T. R., M.A., University, Melbourne ... 1889
Lynch, William, Esq., St. James' Buildings, William-street, Melbourne. 1868

McCoy, Professor Sir F., K.C.M.G., D.Sc., F.R.S. (*President*, 1864), University, Melbourne. 1855
McAlpine, D., Esq., 10 Armadale-road, Armadale ... 1889
Main, Thomas, Esq., City Surveyor's Offices, Melbourne 1881
Masson, Professor Orme, M.A., D.Sc., University, Melbourne 1887
Mathew, Rev. John, M.A., Coburg ... ... ... 1890
Moerlin, C., Esq., Claud Villa, Armadale-road, Armadale 1872
Moors, H., Esq., 498 Punt-road, South Yarra ... ... 1857
Muntz, T. B., Esq., C.E., 358 Collins-street, Melbourne 1870

Nanson, Professor E. T., M.A., University, Melbourne ... 1875
Neild, J. E., Esq., M.D., Bilton House, 21 Spring-street, Melbourne. 1865
Newbery, T. Cosmo, Esq., C.M.G., B.Sc., Technological Museum, Melbourne. 1866
Nimmo, W. H., Esq., C.E., Melbourne Club, Melbourne 1888

Officer, C. G. W., Esq., B.Sc., Glenbervie, Orrong-road, Toorak. 1890
Oldfield, Lenthal, Esq., 36 Nicholson-street, Fitzroy ... 1890

Rudall, J. T., Esq., F.R.C.S., corner Spring and Collins-streets, Melbourne. 1868
Rule, O. R., Esq., Station-street, Canterbury, Victoria ... 1882

Sargood, Sir Fredk. T., K.C.M.G., M.L.C., Elsternwick 1883
Shaw, Thomas, Esq., Woorywoorite, Camperdown ... 1883
Spencer, Professor W. Baldwin, M.A., University, Melb. 1887
Stillwell, Alfred, Esq., 195a Collins-street East ... 1892
Sugden, Rev. E. H., B.A., B.Sc., Queen's College, Carlton 1889
Sutherland, Alexander, Esq., M.A., Heronswood, Dromana 1875
Sweet, George, Esq., F.G.S., Wilson-street, Brunswick ... 1887
Syme, G. A., Esq., M.B., F.R.C.S., 74 Collins-street ... 1890

Tisdall, H. T., Esq., F.L.S., Washington-street, Toorak ... 1883
Topp, C. A., Esq., M.A., LL.B., F.L.S., Grandview Grove, Armadale. 1887

Wilson, Rev. F. R. M., The Manse, Highbury Grove, Kew 1893
Wilkinson, W. Percy, Esq., Government Analyst's Office, Swanston-street. 1894

## Country Members.

Barber, Rev. H. Bride, Parsonage, Beaufort ... ... 1895

Cameron, John, Esq., Orbost ... ... ... 1888
Clark, Donald, Esq., B.C.E., School of Mines, Bairnsdale 1892
Conroy, Jas. McDowall, Wingham, Manning River, N.S.W. 1877

Dawson, J., Esq., Rennyhill, Camperdown ... ... 1887
Desmond, John, Esq., Warrnambool ... ... ... 1891
Dobson, A. Dudley, Esq., M.I.C.E., F.G.S., Warrnambool 1891

Fardy, M. J., Esq., California Gully, Bendigo ... ... 1893
Field, William Graham, Esq., C.E., 228 Hoddle-street, Abbotsford. 1880
Foord, George, Esq., Boundary-road, Burwood... ... 1871

Ivey, James, Esq., Ballarat ... ... ... 1888

Loughrey, B., Esq., M.A., C.E., 3 Elgin-street, Hawthorn 1880

Macgillivray, P. H., Esq., LL.D., M.A., M.R.C.S., Bendigo 1857
Manson, Donald, Esq., Elgin Buildings, Sydney, N.S.W. 1884
Murray, Stuart, Esq., C.E., Department of Mines, Melb. 1874

Oddie, James, Esq., Dana-street, Ballarat ... ... 1882
Officer, Sydney W., Maryvale, Goroke ... ... 1895
Oliver, C. E., Esq., C.E., Metropolitan Board of Works, Collins-street West. 1879

Powell, Walter T. D., Esq., Harbour Department, Brisbane, Queensland. 1886

Purdie, A., Esq., M.A., School of Mines, Ballarat ... 1892

Shaw, W. H., Esq., Phœnix Foundry, Ballarat ... 1888

Williams, Rev. W., F.L.S., Wesleyan Parsonage, North Melbourne. 1885
Wilson, J. B., Esq., M.A., F.L.S., Church of England Grammar School, Geelong. 1880

## Corresponding Members.

Bailey, F. M., Esq., The Museum, Brisbane ... ... 1880

Clarke, Hyde, Esq., 32 St. George's-square, London, L.W. 1883

Dendy, Arthur, Esq., D.Sc., F.L.S., Canterbury College, Christchurch, N.Z. 1888

Etheridge, Robt., Esq., Junr., Department of Mines, Sydney, N.S.W. 1877

Lucas, A. H. S., Esq., M.A., B.Sc., Newington College, Sydney. 1885

Stirton, James, Esq., M.D., F.L.S., 15 Newton-street, Glasgow. 1880
Ulrich, Professor G. H. F., F.G.S., Dunedin, Otago, N.Z. 1857

Wagner, William, Esq., LL.D., Philadelphia, U.S.A. ... 1884

ASSOCIATES.

lan, M. J., Esq., 318 Smith-street, Collingwood ... 1887
;kinson, James A., Esq., 2 Mary-street, Windsor ... 1894
/ery, D., Esq., M.Sc., Queen's College, University, Melb. 1893

,ge, C., Esq., M.D., Achernar, 81 Toorak-road, South Yarra. 1885
,ker, Thomas, Esq., Bond-street, Abbotsford ... 1889
,le, W. M., Esq., Walpole-street, Hyde Park, Kew ... 1887
,rnard, Robt. J. A., Esq., M.A., Queen's College, Carlton 1892
st, Heinrich, Esq., c/o Mr. H. Falkner, Nightingale-street, Balaclava. 1890
van, Rev. L. D., D.D., LL.B., Congregational Hall, Russell-street. 1889
oth, John, Esq., C.E., Rennie-street, Coburg ... 1882
wen, W., Esq., 358 Collins-street, Melbourne ... 1887

mpbell, A. J., Esq., F.L.S., Elm Grove, Armadale ... 1894
.ampion, H. V., Esq., C.E., Council Chambers, Williamstown. 1882
.ase, L. H., Esq., Currajong, Riversdale-road, Hawthorn 1885
aig, Robt. Esq., M.A., The Avenue, East Malvern ... 1890
esswell, Rev. A. W., M.A., St. John's Parsonage, Camberwell. 1887

,nks, A. T., Esq., 42 Bourke-street West ... ... 1883
,wson, W. S., M.C.E., Esq., Runnymede, Essendon ... 1887

wards, J. E., Esq., Colonial Telegraph Exchange, 133 Little Collins-street, Melbourne 1879

rguson, W. H., Esq., 23 Service-street, Albert Park ... 1894
elder, Rev. W. Norwood, Mitchell-street, St. Kilda ... 1892
aney, W. H., Esq., Bridport-street, South Melbourne... 1881
son, Rev. Lorimer, M.A., Essendon ... ... 1889

briel, J. Esq., Simpson's-road, Collingwood ... ... 1887

ıig, R. G., Esq., Bank Place, Collins-street, Melbourne 1888
ırt, T. S., Esq., M.A., Wilson-street, Brighton ... 1894
ll, W. H. F., Esq., Glenrowan, Dandenong-road, Windsor 1894
)lmes, W. A., Esq., Telegraph Engineer's Office, Railway Department, Melbourne. 1879
ıbbard, J. R., Esq., 125 Queen-street, Melbourne ... 1884

gamells, F. N., Esq., Observatory, Melbourne ... 1889

Kernot, Frederick A., Esq., Royal Park, Hotham .. 1881
Kirkland, J. B., Esq., F.C.S., University, Melbourne ... 1879
Kitson, A. E., Esq., 372 Albert-street, East Melbourne... 1894

Lambert, Thomas, Esq., Bank of New South Wales, Collins-street. 1890
Le Souëf, Dudley, Esq., Zoological Gardens, Royal Park 1894
Lidgey, E. A., Esq., Department of Mines, Melbourne ... 1894

Maclean, C. W., Esq., Walsh-street, South Yarra ... 1879
Melville, A. G., Esq., Mullen's Library, Collins-street East 1889
Moors, E. M., Esq., M.A., University, Sydney, N.S.W.... 1885

Phillips, A. E., Esq., c/o Mr. Gordon, Little Flinders-street West 1883
Pritchard, G. B., Esq., Mantell-street, Moonee Ponds ... 1892

Quarry, Herbert, Esq., Electrical Foreman, G.P.O., Melbourne. 1880

Robinson, C. A., Esq., Lands Department, Melbourne ... 1894

Schaefer, R., Esq., Union-street, Windsor ... ... 1883
Shephard, John, Esq., 135 City-road, South Melbourne ... 1894
Slater, H. A., Esq., 121 Collins-street, Melbourne ... 1882
Steele, W. H., Esq., M.A., Sherwood-street, Richmond ... 1892
Stewart, C., Esq., 9 Murphy-street, South Yarra ... 1883
Strettle, W. S., Esq., Public Works Dept., Perth, W.A. 1891

Tate, Frank, Esq., B.A., Charlton ... ... ... 1889
Tipping, Isaac, Esq., C.E., Meath House, Millswyn-street, South Yarra. 1892

# LIST OF THE INSTITUTIONS AND LEARNED SOCIETIES THAT RECEIVE COPIES OF THE "TRANSACTIONS" AND "PROCEEDINGS" OF THE ROYAL SOCIETY OF VICTORIA.

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| | |
|---|---|
| Agent-General of Victoria | London |
| Anthropological Institute | London |
| Balfour Library | Cambridge |
| Biological Society of Liverpool | Liverpool |
| Bodleian Library | Oxford |
| British Museum | London |
| Colonial Office Library | London |
| "Electrician" | London |
| Foreign Office Library | London |
| Free Public Library | Liverpool |
| Geological Society | London |
| Institute of Mining and Mechanical Engineers | Newcastle |
| Institution of Civil Engineers | London |
| Linnæan Society | London |
| Literary and Philosophical Society | Liverpool |
| Literary and Philosophical Society | Manchester |
| Manchester Museum, Owens College | Manchester |
| Marine Biological Laboratory | Plymouth |
| Natural History Museum | London |
| Naturalists' Society | Bristol |
| "Nature" | London |
| "Natural Science" | London |
| Owens College Library | Manchester |
| Patent Office, 25 Southampton Building | London |
| Philosophical Society | Cambridge |
| Radcliffe Library | Oxford |
| Royal Asiatic Society | London |
| Royal Astronomical Society | London |
| Royal College of Science | South Kensington |
| Royal Colonial Institute | London |
| Royal Gardens | Kew |
| Royal Geographical Society | London |
| Royal Microscopical Society | London |
| Royal Society | London |
| Statistical Society | London |
| University College | London |
| University Library | Cambridge |
| Yorkshire College | Leeds |

## SCOTLAND.

| | |
|---|---|
| Botanical Society ... ... ... ... | Edinburgh |
| Geological Society ... ... ... ... | Edinburgh |
| Royal College of Physicians' Laboratory ... ... | Edinburgh |
| Royal Observatory ... ... ... ... | Edinburgh |
| Royal Physical Society ... ... ... | Edinburgh |
| Royal Society ... ... ... ... | Edinburgh |
| Royal Scottish Society of Arts ... ... ... | Edinburgh |
| Scottish Geographical Society ... ... ... | Edinburgh |
| University Library ... ... ... ... | Edinburgh |
| University Library ... ... ... ... | Glasgow |

## IRELAND.

| | |
|---|---|
| Natural History and Philosophical Society ... | Belfast |
| Royal Dublin Society ... ... ... ... | Dublin |
| Royal Geological Society ... ... ... | Dublin |
| Royal Irish Academy ... ... ... ... | Dublin |
| Trinity College Library ... .. ... | Dublin |

## GERMANY.

| | |
|---|---|
| Gesellschaft für Erdkunde ... ... ... | Berlin |
| Grossh. Hessische Geologische Anstalt ... ... | Darmstadt |
| Jenaische Zeitsch. f. Medicin und Naturwissenschaft | Jena |
| Königl. Botanische Gesellschaft ... ... | Regensburg |
| Königl. Offentl. Bibliothek ... ... ... | Dresden |
| Königl. Preussische Akademie der Wissenschaften ... | Berlin |
| Königl. Sächs Gesellschaft der Wissenschaften ... | Leipzig |
| Königl. Societät der Wissenschaften ... ... | Göttingen |
| Naturforschende Gesellschaft ... ... ... | Emden |
| Naturforschende Gesellschaft ... ... .. | Halle |
| Naturforschende Gesellschaft ... ... ... | Leipzig |
| Naturhistorisch Medizinischer Verein ... ... | Heidelberg |
| Naturhistorisches Museum ... ... ... | Hamburg |
| Naturhistorisches Museum ... ... ... | Hanover |
| Naturwissenschaftlicher Verein ... ... ... | Bremen |
| Naturwissenschaftlicher Verein ... ... ... | Frankfurt |
| Oberhessische Gesellschaft für Natur & Heilkunde ... | Giessen |
| Schlesische Gesellschaft dür Vaterländ, Cultur ... | Breslau |
| Verein für Erdkunde ... ... ... ... | Darmstadt |
| Verein für Erdkunde ... ... ... ... | Halle |
| Verein für Naturkunde ... ... ... | Kassel |

## AUSTRIA AND HUNGARY.

| | |
|---|---|
| Imperial Observatory ... ... ... ... | Prague |
| K. K. Akademie der Wissenschaften ... ... | Wien |

| | | |
|---|---|---|
| K. K. Geologische Reichsanstalt | ... ... | Wien |
| K. K. Geographische Gesellschaft | ... ... | Wien |
| K. K. Naturhistorisches Hofmuseum | ... ... | Wien |
| Magyar Kiralyi Termestuddomanyi Tarsulat | ... | Budapest |

### SWITZERLAND.

| | | |
|---|---|---|
| Geographische Gesellschaft | ... ... ... | Berne |
| Geogr. Commerc. Gesellschaft | ... ... ... | St. Gallen |
| Geogr. Commerc. Gesellschaft | ... ... ... | Aarau |
| Naturforschende Gesellschaft | ... ... ... | Zurich |
| Schweizerische Naturforschende Gesellschaft | ... | Berne |
| Société de Physique et d'Histoire Naturelle | ... | Genéve |

### FRANCE.

| | | |
|---|---|---|
| Académie des Sciences des Belles-Lettres et des Arts | | Lyon |
| Annuaire Geologique Universel | ... ... ... | Paris |
| Faculté des Sciences | ... ... ... ... | Marseilles |
| Feuilles des Jeunes Naturalists | ... ... ... | Paris |
| Société Académique Indo-Chinoise | ... ... | Paris |
| Société de Geographie | ... ... ... ... | Paris |
| Société d'Etudes Scientifiques | ... ... ... | Paris |
| Société Nationale de Cherbourg | ... ... ... | Cherbourg |
| Société Zoologique de France | ... ... ... | Paris |
| Soc. des Sciences Naturelles de l'Ouest de la France (Museum) | ... ... ... ... | Nantes |

### ITALY.

| | | |
|---|---|---|
| Biblioteca Nazionale Centrale Vittorio Emanuele | ... | Rome |
| British and American Archæological Society | ... | Rome |
| Museo di Zoologia ed Anatomia Comp., R. Universitá | | Turin |
| Ministero dei Lavori Pubblici | ... ... ... | Rome |
| R. Accademia della Scienze dell Institut | ... ... | Bologna |
| Reale Academia di Scienze | ... ... ... | Palermo |
| Reale Academia di Scienze, Lettre ed Arti | ... | Lucca |
| Regia Academia di Scienze, Eettere ed Arti | ... | Modina |
| Societá Geografica Italiana | ... ... ... | Rome |
| Societá Toscana di Scienze Naturali | ... ... | Pisa |
| Zoological Station | ... ... ... ... | Naples |

### SPAIN AND PORTUGAL.

| | | |
|---|---|---|
| Real Academia de Ciencias Exactas, Fisicas y Naturales | | Madrid |
| Sociedade de Geographio | ... ... ... | Lisbon |

## Holland and Belgium.

| | |
|---|---|
| Académie Royale de Belgique ... ... ... | Bruxelles |
| Bataviaasch Genootschap van Kunsten en Wetenschappen, Soc. Roy. des Sciences naturelles de Céans ... ... ... ... ... | Batavia |
| Musée Teyler ... ... ... ... | Haarlem |
| Magnetical and Meteorological Observatory ... | Batavia |
| Natural Science Society ... ... ... | Amsterdam |
| Natuurkundig Genootschap ... ... ... | Groningen |
| Nederlandisch Botan. Vereiniging ... ... | Nijmegen |
| Royal Academy of Sciences ... ... ... | Amsterdam |
| Société Hollandaise des Sciences ... ... | Haarlem |
| Société Malacologique Royale de Belgique ... | Bruxelles |
| Société Provinciale des Arts et Sciences ... ... | Utrecht |

## Denmark, Sweden, and Norway.

| | |
|---|---|
| Académie Royale ... ... ... ... | Copenhagen |
| Entomologiska Foreningen ... ... ... | Stockholm |
| Societé des Sciences ... ... ... ... | Christiania |
| Swedish Academy of Sciences ... ... ... | Stockholm |
| University ... ... ... ... ... | Upsala |

## Russia and Roumania.

| | |
|---|---|
| Institut Météorologique de Roumanie ... ... | Bucharest |
| Jardin Botanique Impérial ... ... | St. Petersburg |
| Soc. des Naturalistes de l'Université de Kazan ... | Kazan |
| Soc. des Naturalistes Kiew ... ... ... | Kiew |
| Société des Naturalistes de la Nouvelle Russie ... | Odessa |
| Société Impériale des Naturalistes ... ... | Moscow |
| Société Impériale Russee de Géographie ... | St. Petersburg |

## Cape of Good Hope.

| | |
|---|---|
| South African Philosophical Society Observatory ... | Cape Town |

## India and Mauritius.

| | |
|---|---|
| Geological Survey of India ... ... ... | Calcutta |
| Madras Literary Society ... ... | Madras |
| Meteorological Society... ... ... ... | Mauritius |
| Natural History Society ... ... ... | Bombay |
| Royal Bengal Asiatic Society ... ... ... | Calcutta |
| Royal Asiatic Society, Ceylon Branch ... ... | Colombo |

### China and Japan.

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| ıomical Observatory ... ... | ...Hong Kong |
| Branch of the Royal Asiatic Society | ... Shanghai |
| ial University ... ... ... | ... Tokio |
| ›logical Society of Japan ... ... | ... Tokio |

### Canada.

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| ian Institute ... ... ... | ... Toronto |
| ;ical and Natural History Survey of Canada ... | Ottawa |
| Society of Canada ... ... | ... Montreal |

### United States.

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| my of Natural Sciences ... ... | ... Davenport |
| my of Natural Sciences ... ... | Philadelphia |
| my of Sciences ... ... ... | San Francisco |
| can Academy of Arts and Sciences ... | ... Boston |
| can Geographical Society ... ... | ... New York |
| can Philosophical Society ... ... | Philadelphia |
| Library ... ... ... | ... New York |
| u of Ethnology ... ... ... | Washington |
| do Scientific Society ... ... | ... Denver |
| r Union for the Advancement of Science & Art | New York |
| ›n University ... ... ... | ... Ohio |
| Hopkins University ... ... | ... Baltimore |
| nos" ... ... ... ... | St. Francisco |
| and Historical Society ... ... | ... Baltimore |
| al Academy of Sciences ... ... | Washington |
| of Chief of Engineers, U.S. Army ... | Washington |
| ophical Society ... ... ... | Washington |
| ıce" ... ... ... ... | ... New York |
| sonian Institute ... ... ... | Washington |
| y of Natural History ... ... | ... Boston |
| y of Natural Sciences ... ... | ... Buffalo |
| Academy of Sciences ... ... | ... Austin |
| d States Geological Survey ... | Washington |
| rsity of California ... | Berkley, San Francisco |
| nsin Academy of Sciences, Arts, and Letters ... | Madison |

### Mexico.

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| ;erio de Fomento ... ... | ... Mexico |
| vatorio Meteorologico, Magnetico Central | ... Mexico |
| vatorio Astronomico National ... | ... Tatubaya |
| ade Cientifica, Antonio Alsate ... | ... Mexico |
| aria de Fomento ... ... | ... Guatemala |

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